

1

POSTMORTEM TECHNIQUES



Postmortem techniques

- Postmortem is also known as
 - Autopsy
 - Necropsy
 - Thanatopsy
 - Postmortem examination (PME).
- **Necropsy** is the study of a dead body.
- **Necro** means Dead body.
- Study of death is known as **Thanatology**.
- Procedures involved in thanatology are known as **Thanatopsy**.

History

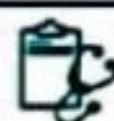
- **The 1st autopsy** was conducted in 1302, by **Varignana** in Italy.
- **The 1st medico-legal autopsy** in India was conducted by **Buckley** on the body of **Mr. Wheeler** in **Chennai**.

Q1. What is the case of the 1st medico-legal autopsy in India?

Ans: Arsenic poisoning.

Autopsy Types

00:02:39



Important Information

- In Court of Law or Legal Procedures we have 2 types, Police & Magistrate inquest.

A. Medicolegal Autopsy

- It is on the inquest of either police/magistrate.
- **174 CrPC** for police inquest.
- **176 CrPC** for magistrate inquest.
- This autopsy is chosen for **unnatural deaths**.
- **Relative consent is not required**.
- It is for law purposes.
- It is done for the **whole body**.
- It is done to know the cause of death, time since death, and manner of death.
- **Most common** type in **India** due to the higher number of unnatural deaths.
- The dead body is returned to the investigating officer.
- It is done by a Forensic expert, RMP (Registered Medical Practitioner).

B. Pathological/Clinical Autopsy

- **Relative consent is mandatory**.
- It is mostly done in **natural deaths**.
- It is for a specific body cavity autopsy. **Ex:** Death due to MI is examined for the heart.
- The dead body is returned to the relative.
- It is for **academic purposes** or to improve knowledge.
- It is done by RMP (Registered Medical Practitioner).

C. Psychological Autopsy

- A person **committed suicide** is first done with a psychological autopsy prince kumar autopsyeeekum@gmail.com 9928609733
- It is **not a PME**, it is an interview with family members of the dead person.
- It is performed to know the **mental status** of the person before suicide.
- The interview is done with family members, friends, relatives, and social media.

D. Virtual Autopsy

- It is a visual imaging technique performed in developed countries.
- It is done to find the cause of death
- **CT scan and MRI** is performed for knowing the cause of death.
- It is also known as **virtopsy**.

E. Negative Autopsy

- If there is no identification of the cause of death, after performing PME, lab investigations, and histopathological & toxicological studies.
- Prevalence of negative autopsies is **2-5%**.
- It may sometimes occur due to a lack of experience or skill.
- In cases like **vagal inhibition, laryngospasm, and epilepsy** there is a chance of a negative autopsy.
- Negative autopsy is a **completely negative finding**.

F. Obscure Autopsy

- In this autopsy we can obtain **minimal or inconclusive** findings, which is insufficient to give a conclusion.
- **Additional investigations** like lab investigations, histopathological & toxicological studies are used to conclude the cause of death.
- Obscure autopsy is a **minimal gross finding**.

Postmortem Techniques

00:14:18

A. Virchow's Method (MC)

- **Very common** method.
- **One-by-one organ removal**.
- Fast and easy method.

B. Ghon's/ en-Block Method (G-B)

- **Targeted block (C/T/A/P)** is taken out.
- **Cervical, thoracic, abdominal, pelvic blocks** are taken out based on the requirement.
- **Thoracic block** is taken out in thoracic problems.
- **Pelvic block** is taken out in sexual assaults.
- Inter-organ relations are intact.

C. Lettule's/en-Masses/Evisceration

- Large masses (C+T+A+P) are taken out.
- Complete viscera is taken out (Evisceration).
- Blood vessels and vascular supply are intact.
- It is for minor bleeding.

Q2. Which method is used for simple bleeding?

Ans: Lettule's/en-masses/Evisceration.

D. Rokitansky/ In-situ Method

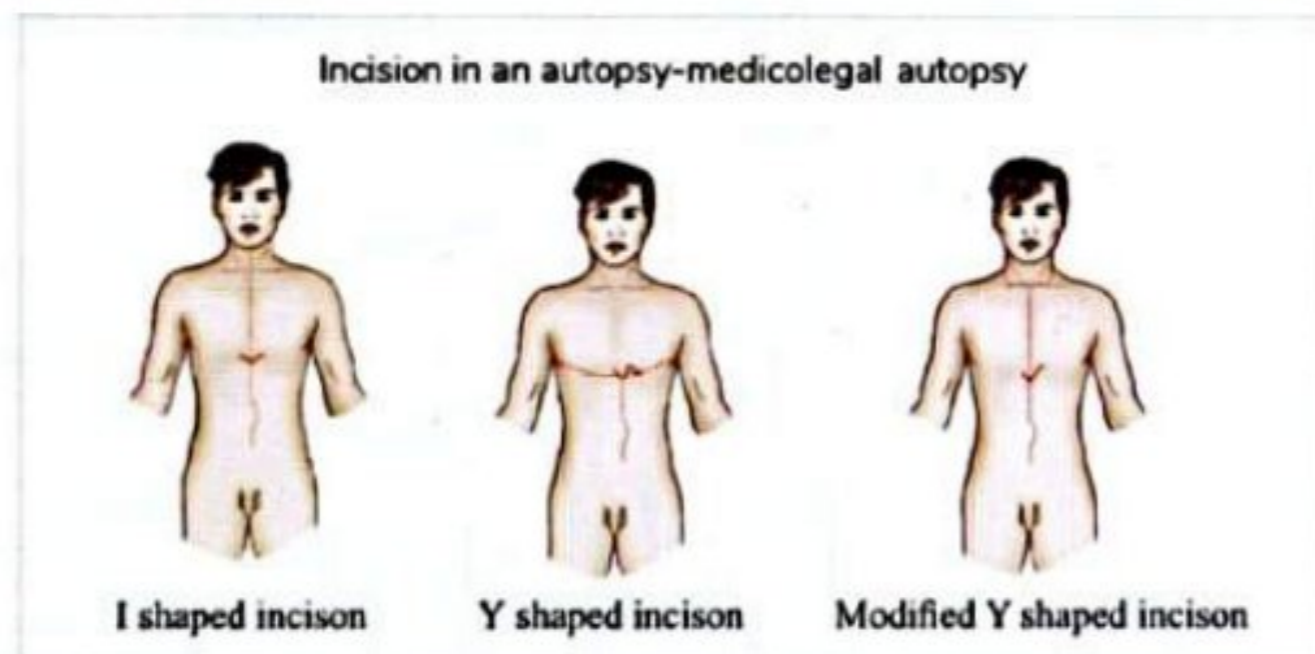
- It is an inside dissection.
- It is done in infectious diseases (HIV, Hepatitis, COVID-19).
- It is used in highly transmissible diseases.
- It is used in infants <1 year.

Q3. If a person died due to COVID-19, which postmortem technique is required?

Ans: If there is a hospital report, there is no requirement of conducting PME, because it is a transmissible disease. If it is a medicolegal case, the Rokitansky/ in-situ method is performed.

Types of Incisions

00:21:36



A. I-shaped Incision

- Most common type.
- It starts from the chin to pubic symphysis.

B. Y-shaped Incision

- Purpose is cosmetic, to preserve the mamillary line.
- It starts from the acromion process preserving the mamillary line reaches the breast, then to the xiphi-sternum and to pubic symphysis.

C. Modified Y-Shaped Incision

- This is done in fictional deaths (hanging, drowning).
- It starts from MP (mastoid process) to SSN (suprasternal notch) then to pubic symphysis.

D. X-incision

- It is generally not done.
- Two incisions are made from the shoulders to opposite iliac crests.
- It makes an X-mark on the body.
- It is for deep injuries/ custodial deaths.

E. Inverted Y-Shaped Incision

- It is generally not done.
- It starts from the chin and just above the umbilicus it divides into two incisions.
- It is done in infants.

F. T-Shaped Incision

- It starts from shoulder to shoulder, an incision is done in the middle.



Important Information

- Most common is I-Shaped.
- In females it is Y-Shaped for cosmetic purposes.
- In fictional cases it is a Modified Y-Shaped Incision

Body Cavity to be Opened First

00:28:21

- Generally, in PME, the thoracic cavity is opened first.
- In specific cases like.

A. Newborn

- Abdomen is to be opened first.
- Because the position of the diaphragm is seen.
- If the position of the diaphragm is lower, it is a live bone.
- If the position of the diaphragm is higher, it is a dead bone.
- We can estimate that the respiration has taken place or not.

B. Poisoning

- In suspected cases of poisoning, the first cavity to be opened is the cranium.
- Because the best smell of the poison can be perceived by the brain.

C. Asphyxial Deaths

- In this, Cranium-Thoracic-Abdomen-Neck (C-T-A-N) are opened in order.
- Because we want the neck as a bloodless field.
- Eg: In a throttling case, we have multiple bruises around the neck, if blood from other cavities enters the neck it would be a wrong finding.
- Hence, the last cavity opened is the neck.

D. Traumatic Head Injury

- Head is the first cavity to be opened.
- Some books may have head as the last cavity to be opened.

E. Air-Embolism/ Pneumothorax

- Pneumothorax means the air in the pleural cavity.
- In pneumothorax cases, the chest cavity (Thorax) is opened first, the skin flap is taken out and it is filled with water.
- Then puncture the pleura, if a bubble comes out, the water test is positive (Pleura has air).

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- In **air embolism** cases, open the pericardium, fill it with water, and puncture the ventricle.
- If a bubble comes out, the water test is **positive** (Pleura has air).
- Another technique used in air embolism cases, a syringe is taken (**pyrogallol**), and aspirate blood from the ventricle.
- If air is present in the ventricle, the color of the pyrogallol solution turns **brown**.

Organs to be Dissected.

00:36:18

A. Brain

- It is the most **sensitive** organ.
- It can be dissected with/ without fixation.
- Fixation is done with **10% formalin** in a bucket with a string for 1 week if brain study is important.
- A **1 cm** interval is made in the **coronal** section of the brain.

B. Heart

- We use the **inflow-outflow technique**.
- Right atrium-Right ventricle, then to pulmonary artery we dissect up to the Lungs.
- Left atrium-Left ventricle, then dissect up to the Aorta.

C. Spinal cord

- Spinal cord can be opened anteriorly and posteriorly.
- **Posterior opening is considered a better technique**.
- It is opened in spinal cord poison cases like **strychnine** and traumatic spinal injuries.

E. Stomach

- It is done by the **Double Ligature Method**, in both cardiac and pyloric ends.
- It preserves the contents of the stomach.
- It is opened in the **greater curvature**.
- Because, in cases like acid or corrosive poisoning, the maximum damage is on the lesser curvature (**Magenstrasse**)
- To examine the lesser curvature, it opened from greater curvature by the double ligature method.

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F. Intestine

- **Small intestine** is dissected from the **mesenteric border**.
- **Large intestine** is dissected from the **Anterior tenia**.

G. Liver

- Liver is dissected by **Parallel dissection technique**.

Exhumation

00:42:21



Important Information

- Exhumation is digging out of the dead body in presence of a magistrate.

- It is done in the presence of a **magistrate, police, doctor**.
- It comes under section 176 (3) CrPC.
- After digging out of the body, a secondary autopsy is done if needed.
- Identify the site with the help of relatives or the accused.
- It is done **early in the morning** because the whole daylight is required.
- There is **no limit for exhumation**, it might continue for a few days too.
- Soil sample (500gm) from the body and control sample is also taken, to make a comparison.
- Bones and tissues are taken for chemical or toxicological analysis.
- Arsenic present in the soil can go into the dead body, this process is known as **postmortem imbibition**.

Definitions

00:46:42

Antemortem thrombus: It is a firm, dark red, **striae of Zahn** coralline platelet thrombus.

Q4. What is the striae of Zahn?

Ans: It is a fine white line of fibrin.

Q5. What is the coralline platelet thrombus?

Ans: It is the alternate layers of platelets and fibrin.

Postmortem Clot

- **Red current jelly:** Blood clots rapidly
- **Chicken fat clot:** The clotting process is slow

Sudden Death

- Death is said to be sudden when a person not known to have been suffering from any dangerous disease, injury, or poisoning is found dead or dies within **24 hours after the onset of terminal illness**.
- Left anterior descending artery (LAD) within 2 cm of its origin is the mostly affected.
- LAD is also called a **Widow artery**.

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ROAD TRAFFIC ACCIDENTS



Topics

- Motorcyclist injuries (accident while riding a bike)
- Pedestrian injuries (accident while walking)
- Vehicle injuries (accidents involving big vehicles)
- The nature or severity of the injury depends on

To Remember

- Speed of vehicle
- Point of impact

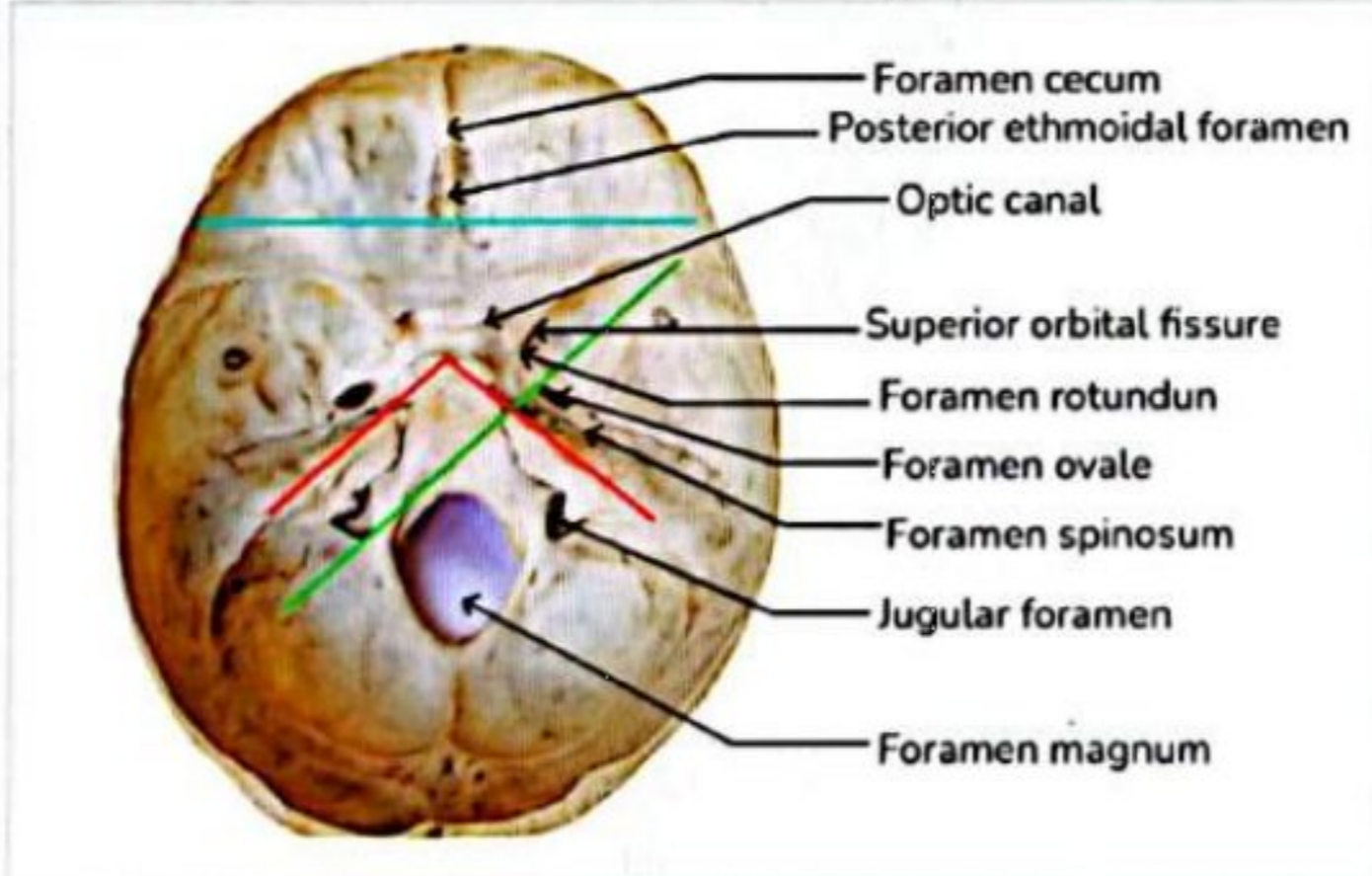
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1. Motorcyclist Injuries

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Motorcyclist fracture

- Motorcyclist fracture is also a type of regional injury (dealt in the Regional injuries chapter).
- **Site:** Base of the skull (BOS).
- It is a **type I hinge** fracture.



- **Pattern:** Petrous site → Sella turcica → Petrous ridges.
- Motorcyclist fracture divides the skull into **2 halves**.
 - Anterior
 - Posterior
- It is a side-by-side fracture (force is from one side and it goes to the other side).

Other Fractures of the BOS

- Type 2 - Green line.
- Type 3 - Blue line (which is in the coronal plane)

Tail gating/ Under Running

- Running into a large/ heavy vehicle from the back.
- **Example:** If any motorcyclist or a person is crushed to the back of a truck/car.
- Head injury is the most common.
- Can also lead to **decapitation of head/** removal of the face or chest or abdomen.

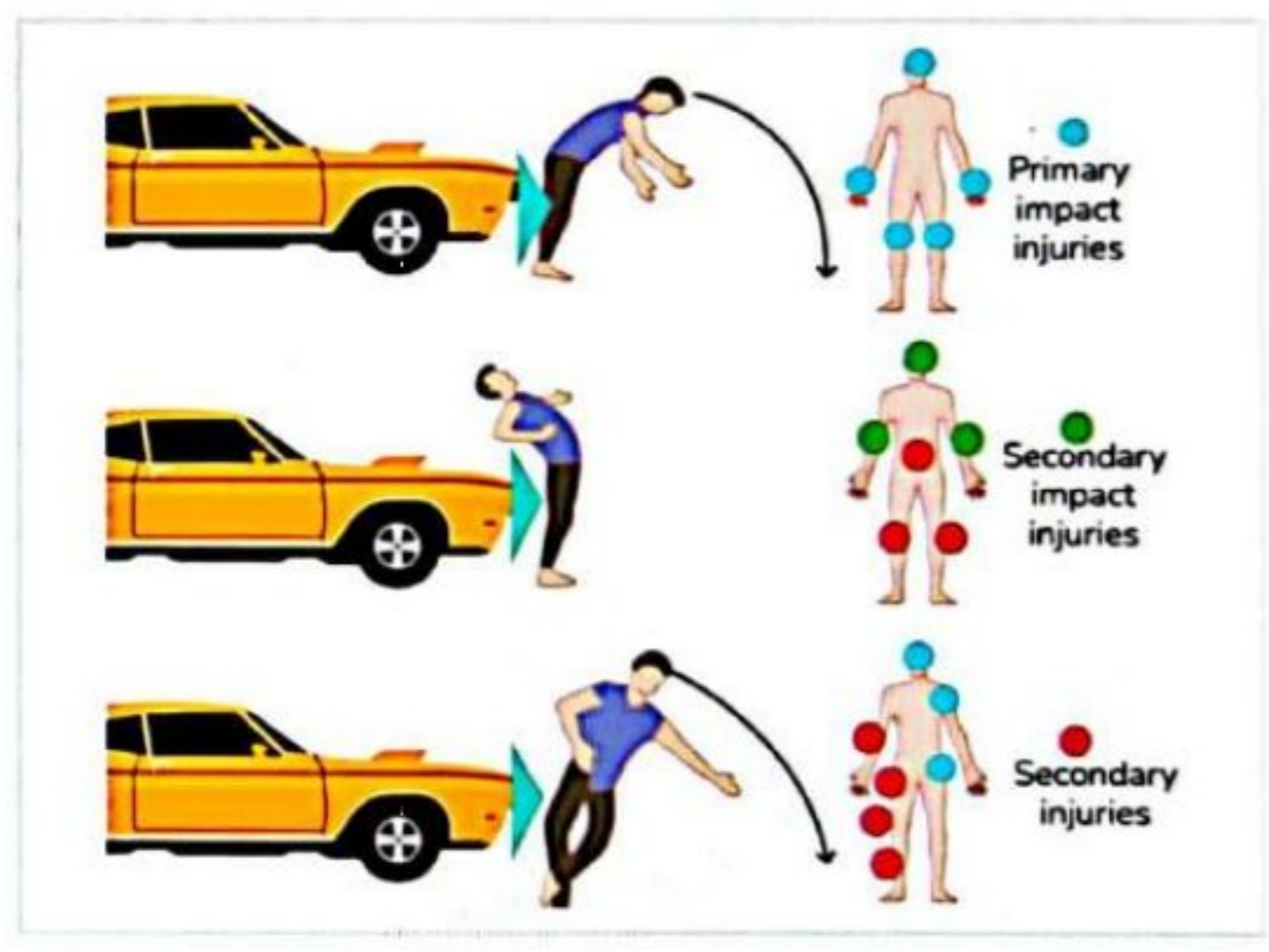
2. Pedestrian Injuries

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- Person walking or standing on the road can meet with an accident.

Types of Pedestrian Injuries

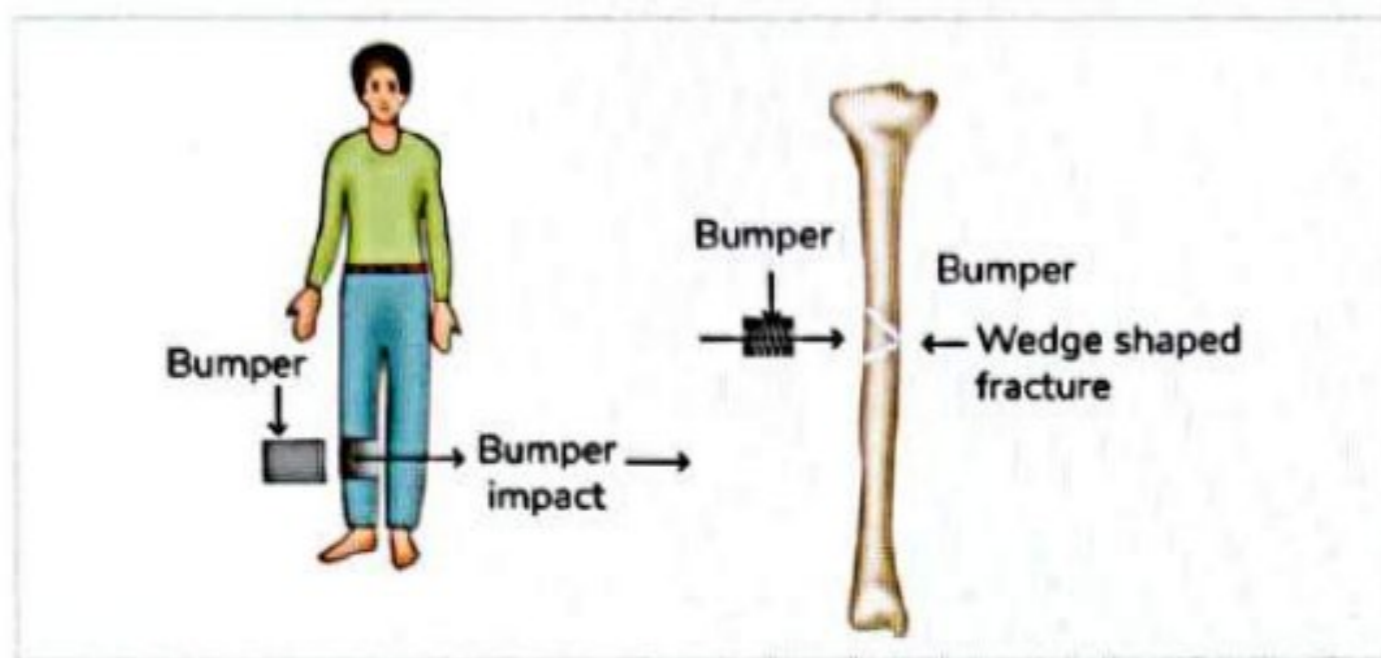
• Primary Impact Injury



- Most common site: Leg
- **Secondary Impact Injury**
 - Hitting by the **same vehicle 2nd time** (or 2nd contact injury).
 - Person moves over the vehicle.
- **Tertiary Impact Injury**
 - Also called secondary injuries.
 - Injury due to impact with an object **other than the same vehicle**.
 - **Objects:** Road, divider, other vehicles, pole.

a. Primary Impact Injury

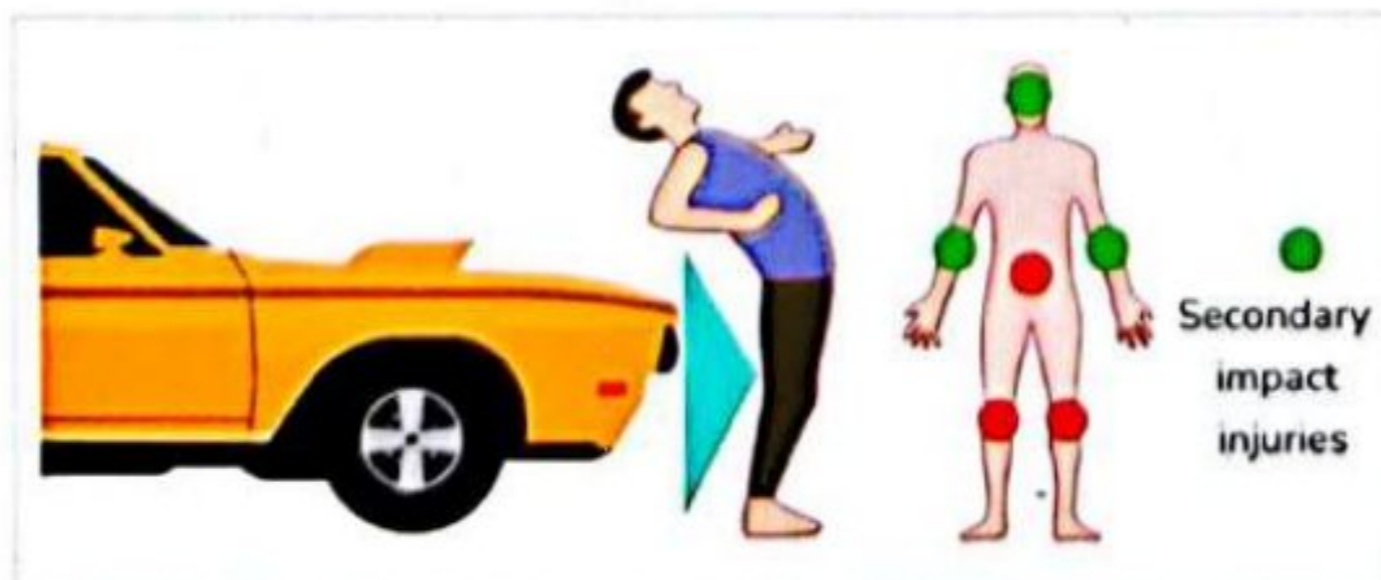
- Bumper of the vehicle is the main object, so the most common injuries are bumper injuries.
- Injuries due to bumper
 - Abrasions
 - Contusions
 - Lacerations
 - Fractures
- **Most common site: Leg.**
- **Adults**
 - Leads to bumper fracture
 - **Most common:** Tibia bone fracture.
 - Mostly on the lateral side of the tibial plateau.
 - **Wedge/triangle-shaped** fracture.
 - **Other parts:** fibula, femur (rarely).



- **Base** is a point of impact (triangle shape)
- **Apex** is the direction of impact (car/ vehicle)
- **Common sites**
 - Leg (tibia) - Adult
 - Femur - Children (as they are short)
- **If the bumper fracture is from the back side**- the vehicle is coming from the backside.
 - **Vehicle movement and location of the injury**
 - **Right to Left** - Lateral aspect right side of the leg
 - **Left to Right** - Lateral aspect left side leg
- **If the bumper fracture is from the front side**-the vehicle is coming from the front side.
- **Victim standing**- Injuries will be at the same level on both legs.
- **Victim running or walking** - Injuries will be at different levels on both legs.
- **Height of injuries**
 - Usually at the same height as the bumper.
 - If the vehicle is speeding (accelerating) - **Higher than the bumper.**
 - If the vehicle applied breaks - **Lower than the bumper.**

b. Secondary Impact Injury

- **Cause:** 2nd contact of the same vehicle.
- Victim may hit the Bonnet or Windshield.
- **Possible injuries**
 - Can lead to multiple injuries.
 - **Most common:** Head injuries.
 - **Other**
 - Cervical fracture or injury
 - Skeletal injuries.



C. Tertiary Impact Injury

- **Also known as** Secondary injuries.
- Hitting other objects.

- **Cause:** May hit the road or get dragged on the road.
- **Possible injuries**
 - **Most common:** Head injuries.
 - Skeletal fractures

Q1. Multiple grazed abrasions and lacerations are due to?
Ans. Getting dragged on the road.

Types of Tertiary Impact Injury

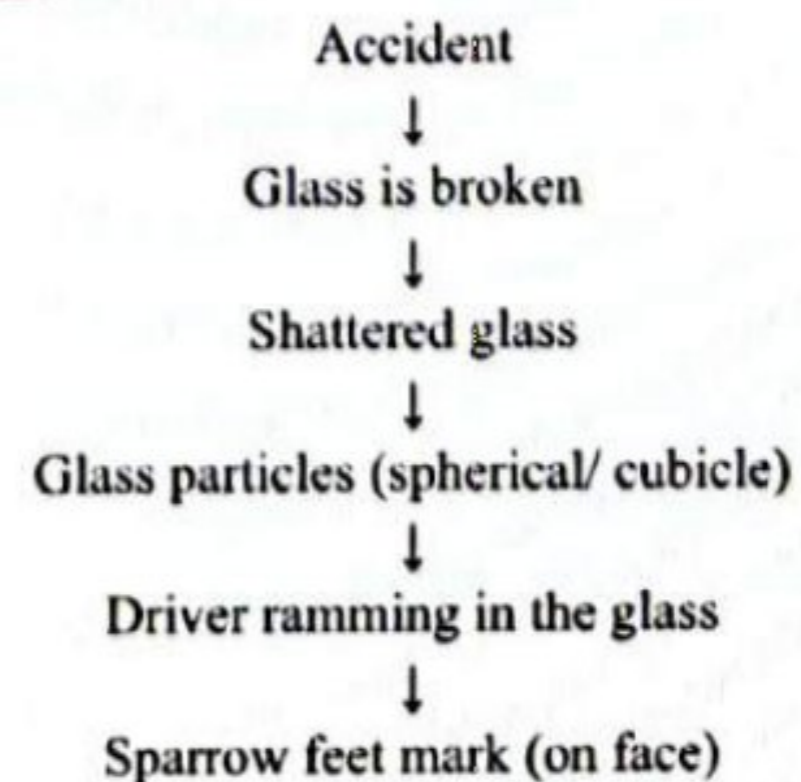
- **Roll-on or Roll-over injuries** (victim rolling on)
 - Caused by vehicles **having low chassis.**
 - **Example:** Car/ Small vehicles like auto.
 - **Characteristics**
 - **Grazed abrasions** - around the circumference.
 - **Fractures** - Of bones.
 - **Patterned abrasions**-Due to the Chassis of the vehicle.
 - **Burning of skin** - Due to hot exhaust.
 - **Grease stains** - Due to grease from the car.
- **Runover injuries** (vehicle runs over)
 - Caused by vehicles **having high chassis.**
 - **Example:** Heavy vehicles like trucks and lorries.
 - **Characteristics**
 - **Tyre marks**-Most specific (patterned abrasions/bruises).
 - **Grazed abrasions** - Multiple abrasions on the body due to friction.
 - **Avulsion** - Separation of tissue (shearing lacerations).
 - **Crushing injuries**-Crushing of head or body or internal organs.
 - **Burning of skin** - Due to hot exhaust.
 - **Grease stains** - Due to grease from the car.

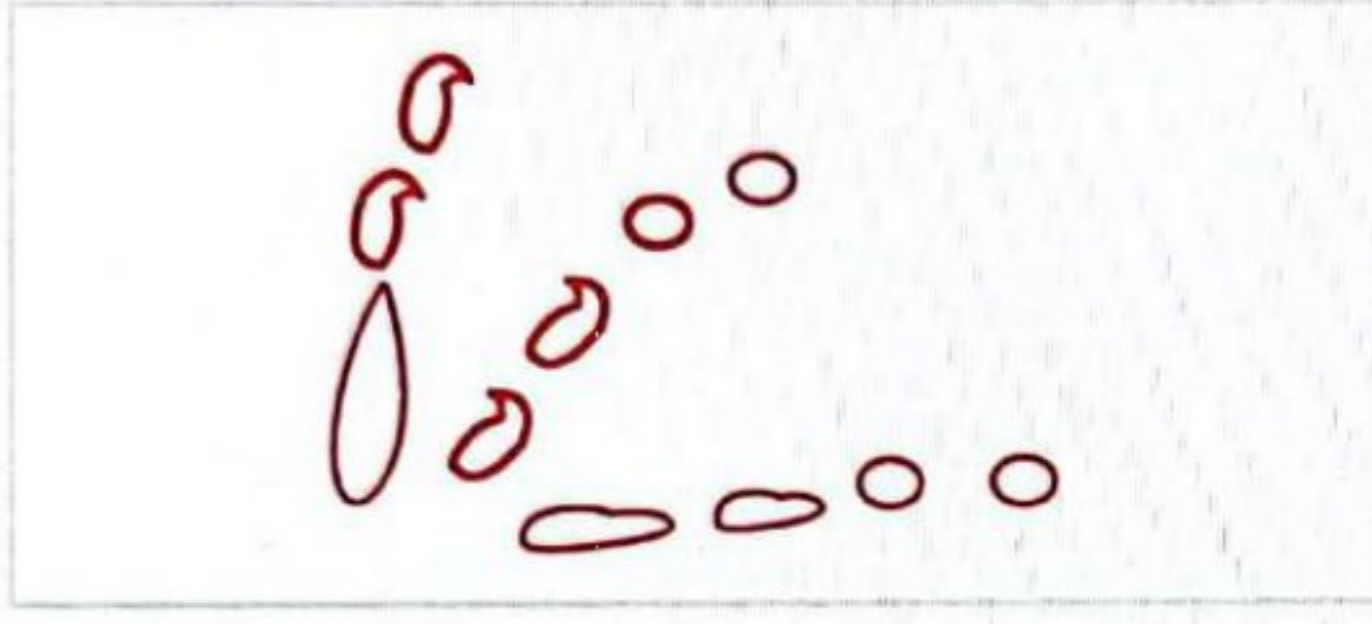
3. Car Occupant Injuries

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- Car has 2 occupants
 - Driver
 - Front seat passenger
- a. **Car Driver Injuries**
 - Windshield Injuries**
 - Leads to Sparrow feet mark (driver is ramming in the glass)
 - Dicing injury (broken glass will fall on the driver)

What happens?





Sparrow feet mark: It is a multiple, small, superficial punctate laceration.

- **Not very common** - As the driver usually wears a seat belt.

Sparrow Foot Mark	Dicing Injury
Not common	Common
Sparrow foot mark is mainly on the face	Can be on both the face and body
The driver is ramming into the glass	Broken glass will fall on the driver

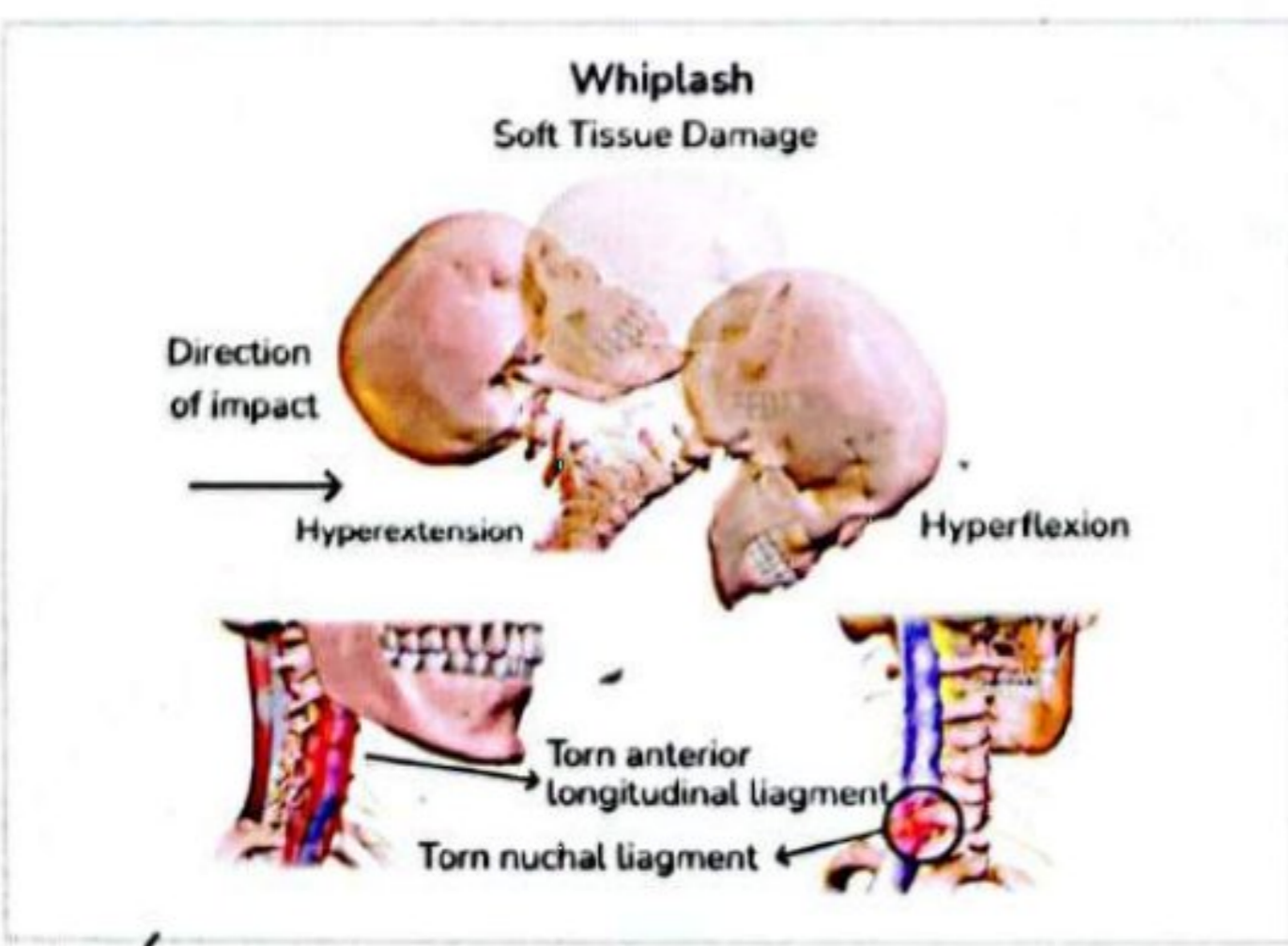
ii. Neck Injuries

- **2 types**
 - Whiplash injury (soft tissue injury)
 - Neck fracture (cervical)
- **Reason:** Violent neck movements.
- **Whiplash injury**
 - **Acceleration**-Hyperextension of the neck followed by hyperflexion.
 - **Deceleration**-Hyperflexion of the neck followed by hyperextension.

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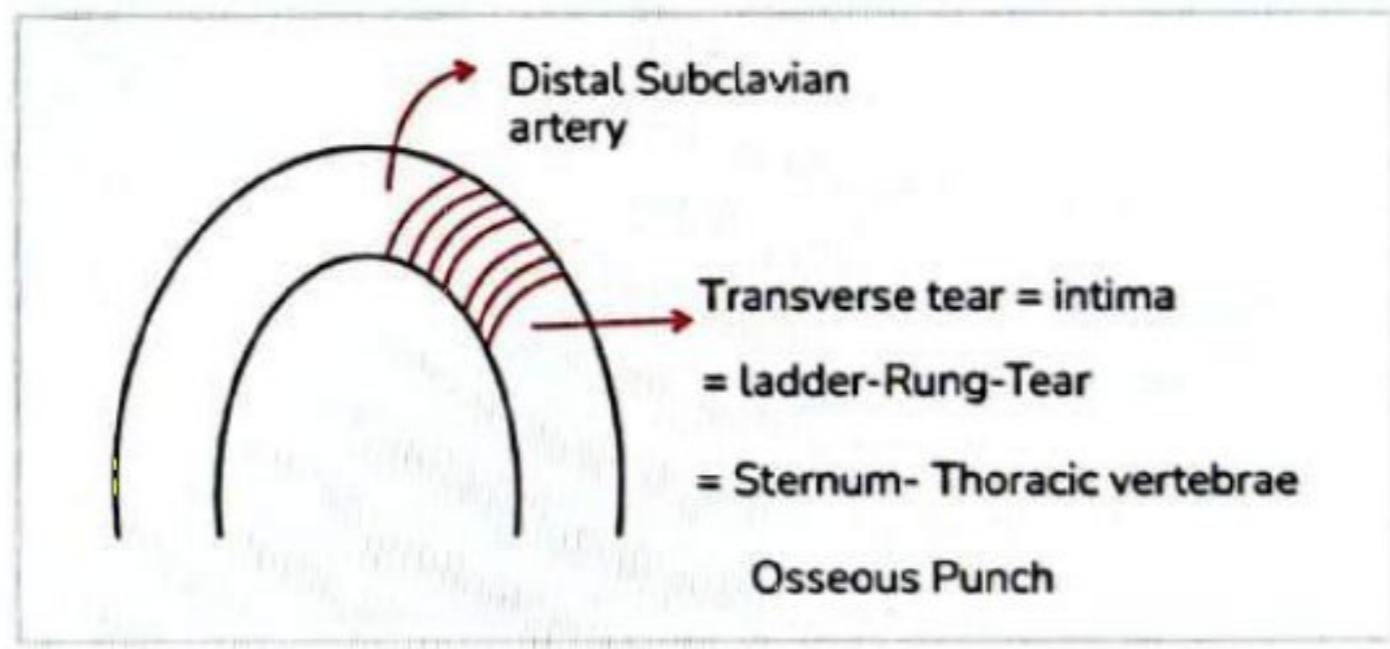
To Remember: More common and dangerous in a Whiplash injury is Hyperextension.

- **Injuries:** Contusion of the soft tissue of the cervical spinal area (fatal).
- **Level:** C5, C6 level.
- **Common site:** Anterior longitudinal ligament.
- Anterior longitudinal ligament and cervical ligaments are torn.



iii. Steering Wheel Injuries

- **Sites**
 - Steering injury - Sternum fracture.
 - Steering injury - Ribs fracture.
 - Other sites: Elbow or forearm.
 - **Chest**-The most common site for Patterned Bruises.
- **Organs involved**
 - Lung
 - Heart
 - Aorta
- Direct impact on the aorta shows **Torsion force**.
- Part involved is the isthmus (distal to the subclavian artery).
- **Ladder rung tear:** There will be a transverse tear in the intima of the isthmus.
- **Osseous punch:** There will be compression between the sternum and thoracic vertebrae.

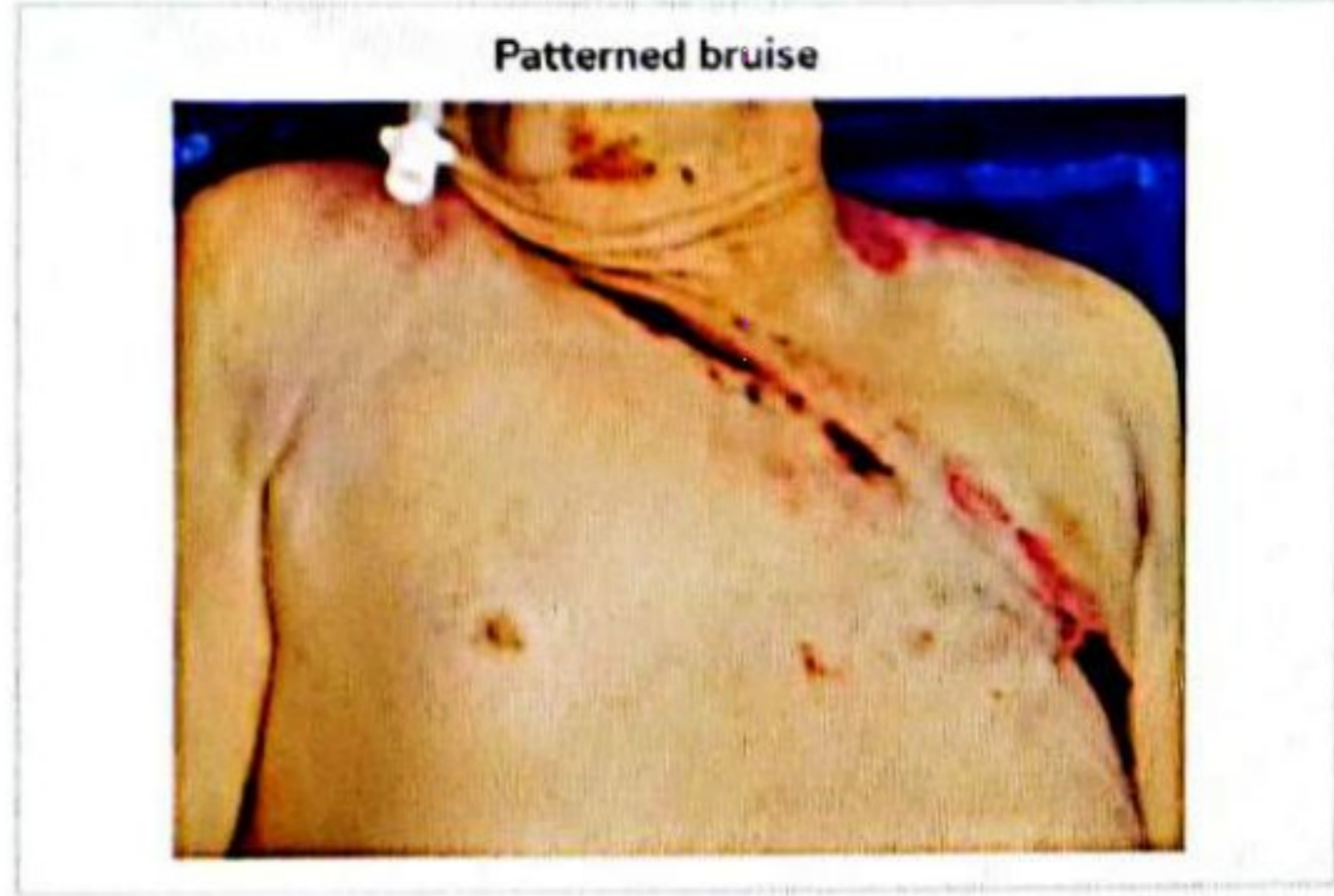


- **Deceleration injury** - Stretching or straining of aorta.

iv. Seat Belt Injuries

Seat belt syndrome, has 3 categories

- **Seat belt sign (Patterned bruise)**
 - In drivers it starts from the right shoulder.
 - In the front passenger it is from the left shoulder.



- **Intra-abdominal injuries**
 - Due to deceleration and compression.
 - **Common sites**

- Mesentery (most common)
- Small intestine-Duodenojejunal flexure (primary), ileocecal junctions (secondary)
- Liver

- **Vertebral injuries**

- Due to distraction and compression.
- **Distraction** (separation of the joint)
 - If only lap belt-Hyperflexion of the spine (lumbar vertebra).
 - Seen on the posterior side
- **Compression**
 - Seen on the anterior side

Chance\Fulcrum fracture: Distraction on posterior side + Compression on anterior side → Posteroanterior fracture of vertebra (transverse fracture).

- **Seat belt syndrome=Seat belt sign + Intra-abdominal injuries + Vertebral injuries**

- b. Front Seat Passenger Injuries**

- All driver injuries are seen in the front seat passenger (except the steering injury).
 - Windshield (**sparrow foot sign, dicing injury**)
 - Whiplash injury (**cervical injury, soft tissue injury**)
 - Seat belt injury (**patterned bruise in the front passenger, starts from the left shoulder**)
 - Instead of steering injury, we can see dashboard injury.

Dashboard Injury

Front seat passenger is sitting in a position, where the knee and hip are flexed

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↓
Accident

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The dashboard will hit the flexed knee

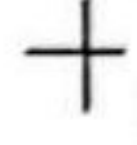
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3 P's

Patella fracture/Posterior cruciate ligament injury/Posterior dislocation of the hip

- **Dashboard dislocation:** Posterior dislocation of hip due to dashboard injury.
- **Most common nerve:** Sciatica nerve.
- Sometimes **femur damage** is also seen.

- Q. Why only posterior dislocation of the hip and not anterior in dashboard injury?
- Q. Why is posterior cruciate ligament injury more common in dashboard injury?
- Q. Why is anterior cruciate ligament injury less common in dashboard injury?

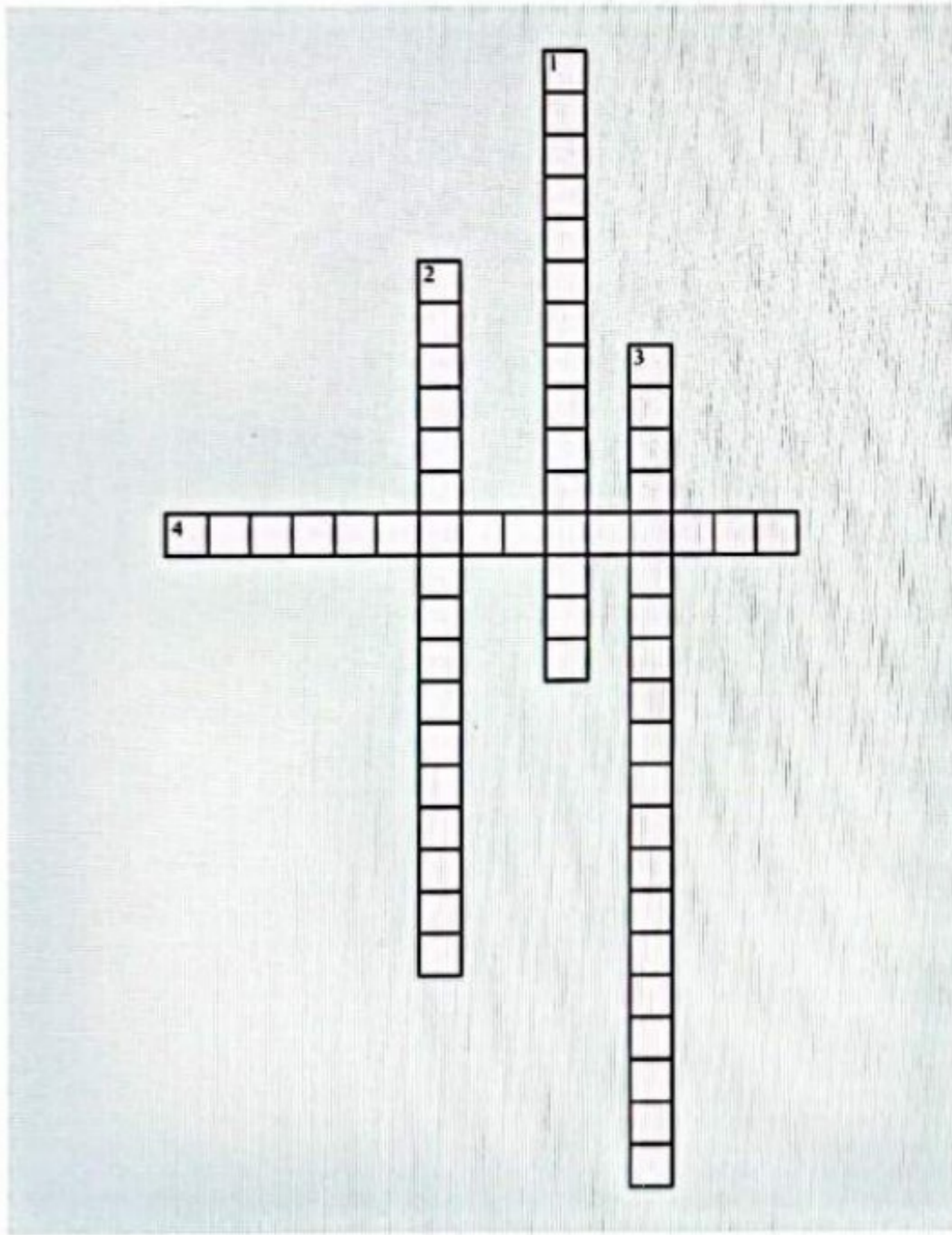
Ans. In the sitting position, the anterior cruciate ligament is relaxed and posterior cruciate ligament is taut.



CROSS WORD PUZZLES



Crossword Puzzle



Across

4. Caused by vehicles having high chassis

Down

1 Front seat passenger is sitting in a position, where the knee and hip are flexed

2 Due to distraction and compression.

3 It is a type I hinge fracture

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Hypothermia

00.00.02

- It happens when the temperature goes below 35°C.
- It happens in old age people, alcoholic people, and in people with diseases.

Signs:

- Clouding of consciousness
- Disorientation
- Loss of Reflex
- Respiratory rate, heart rate, and blood pressure becomes low.

Hypothermia postmortem finding after death

Skin becomes

- Pale that is why it is also known as white death
- Postmortem lividity: bright-pink
- Stomach mucosa: black-brown necrosis (wischnewski-spot)
- Fat necrosis: Pancreas (50% people)
- Lipid depletion: Adrenal gland
- Internal organs: Congested

Hypothermia has 3 phenomenon:

1. Skin: Erythema pernio, skin is red in colour and is painful and pruritic lesions. After this it converts into blisters and oedema. It is also known as chill-blains.
2. Paradoxical undressing: It appears like homicide after sexual assault.
In hypothermia, if the thermoregulatory centre stopped, it causes skin vasodilation. And then the core blood shifts to cutaneous and the person feels warmth and undress.
3. Hide and Die Phenomenon: In this a person becomes disoriented, mental confusion is there and the person hides behind a bench, table, wardrobe, etc. and dies afterwards. That is why it looks like homicide after robbery.

Localized effect of cold

1. Trench foot

- It is also known as immersion foot.
- It is caused due to a moist cold.
- It occurs in soldiers, sellers, and people in the trenches.
- Mechanism: The area becomes red, cyanosis, pulsations are absent, necrosis and gangrene. This leads to formation of erythema
- It is seen at 5 to 8°C

If the hands are immersed in cold places, it is known as trench hands.



2. Frost nip-frostbite

- It is caused due to a dry cold.

Frostnip	Frostbite	
<ul style="list-style-type: none"> • It is the first effect produced by dry cold. • It has a nonfreezing effect. • It is a superficial injury. • It is non-permanent damage. • The mechanism is vasoconstriction. 	<ul style="list-style-type: none"> • It is the second effect produced by dry cold. • It has a freezing effect. • It can be superficial as well as deep injury. • It could be permanent damage. • A mechanism is a form of ice crystals (because frostbite is seen at a freezing temperature of -2.5° c, so that will cause freezing effect and there will be the formation of ice crystals and which will produce ischemia as well as gangrene) 	
<ul style="list-style-type: none"> • There will be numbness, pallor, paller and burning sensation. 	<p>Superficial frostbite</p> <p>Numbness, Burning sensation Blisters with Clear fluid and itching may be present.</p>	<p>Deep frostbite</p> <p>Blisters with hemorrhagic fluid become black because of necrosis and gangrene.</p>
<ul style="list-style-type: none"> • The most common sites are the nose, ear, and face. 	<ul style="list-style-type: none"> • It is always an antemortal injury. 	

- Skin becomes hard and black in two weeks
- Treatment-rewarming is done at 42-44° C, protection from cold, and if there is an infection in the frostbite antibiotics and anti-tetanus treatment.



Heat Injury

Refer Table 13.1

- Most characteristic PM finding of heat stroke is edema/ reduction of purkinje fibre of cerebellum

Local heat injury

- Minimum Temperature
 - 44°C upto 5 to 6 hours
 - 65°C upto 45 Sec

Dry Heat Flame	Moist heat scald Liquid/ Steam
<ul style="list-style-type: none"> • Singeing of hair • Blackening blisters +/- 	<ul style="list-style-type: none"> • Splashing • Sodden and bleached • Line of redness present with vesicles • Charring, Singeing and ulceration. • Scalding can occur through clothes • Clothes worsen the damage

Scald and burn



- Scald is a liquid or steam over the body more than 60°C
- If scald is a liquid or steam over the body more than 70°C, it is called whole thickness scald.

Corrosive or chemical burn

- Ulcerated patches which are free from blisters.
- Hairs are not singed.
- Red line of demarcation absent
- Show distinct coloration

Cause	Dry heat	Moist Heat	Chemical
	Flame	Scald	Corrosive
Site	At and above contact	Below the site	Below the site
Splashing	Absent	Present	Present
Skin	Dry, wrinkled	Sodden, Bleached	Destroyed
Vesicles	At the circumference	Over the burnt area	Rare
Redline	Present	Present	Absent
Colour	Black	Bleached	Distinctive
Charring	Present	Absent	Present
Singeing	Present	Absent	Absent
Ulcer	Absent	Absent	Present
Scar	Thick, contracted	Thin, less contracted	Thick, contracted
Clothes	Burnt	Wet, non burnt	May be burnt

Classification of burn

Dupuytren's	Herbas	Wilson	Modern classification
<ul style="list-style-type: none"> • 1° • 2° • 3° • 4° • 5° • 6° 	<ul style="list-style-type: none"> • 1° • 2° • 3° 	<ul style="list-style-type: none"> • Epidermal • Dermo epidermal • Deep burn 	<ul style="list-style-type: none"> • Superficial burn • Deep burn

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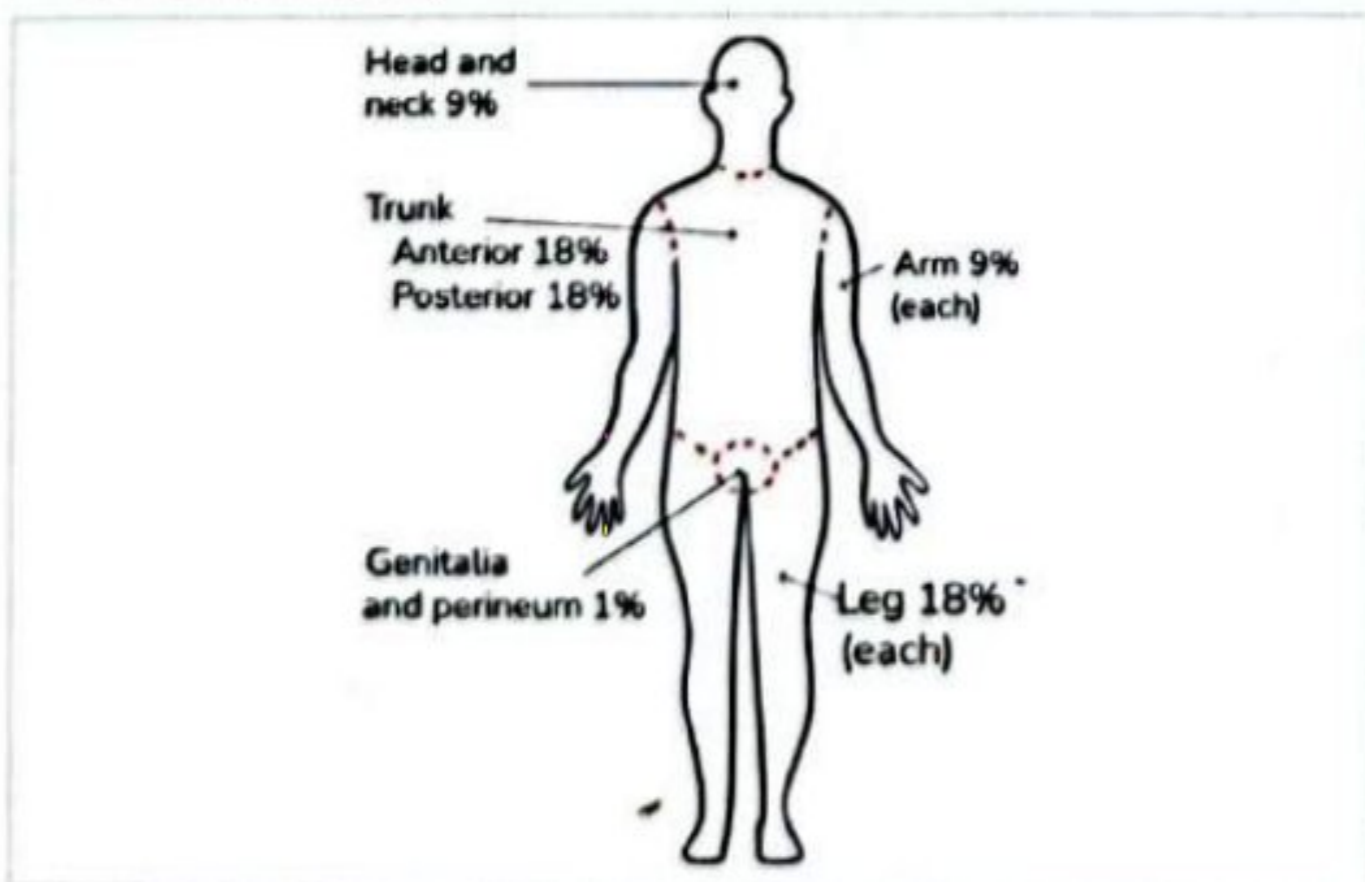
1. Wilson

	Epidermal	Dermo epidermal	Deep
Erythema (redness)	Present	Present	Skin and tissue become white and yellow coloured or black charring of tissue forms eschar.
Pain	Present	Present	
Healing	Spontaneous and complete (takes 1 week)	If it involves the papillary dermis it takes 2 weeks. It is the reticular dermis, it takes 3 weeks.	
Scar	Absent	Present	
Blister	Absent	Present	

- Epidermal to dermo-epidermal, it is called superficial burn and from dermo-epidermal to deep burn, it is called deep burn.
- Dermoepidermal burns are the most painful burns because nerves are exposed.
- Deeper burns are relatively painless because the nerves which transmit the pain become lost.
- Epidermal has dupuytren's 1st and 2nd°, dermo epidermal has dupuytren's 3rd and 4th°, deep burn has dupuytren's 5th and 6th°.
- Epidermal has herbas 1st°, dermo epidermal has herbas 2nd°, deep burn has herbas 3rd°.

Necklacing:

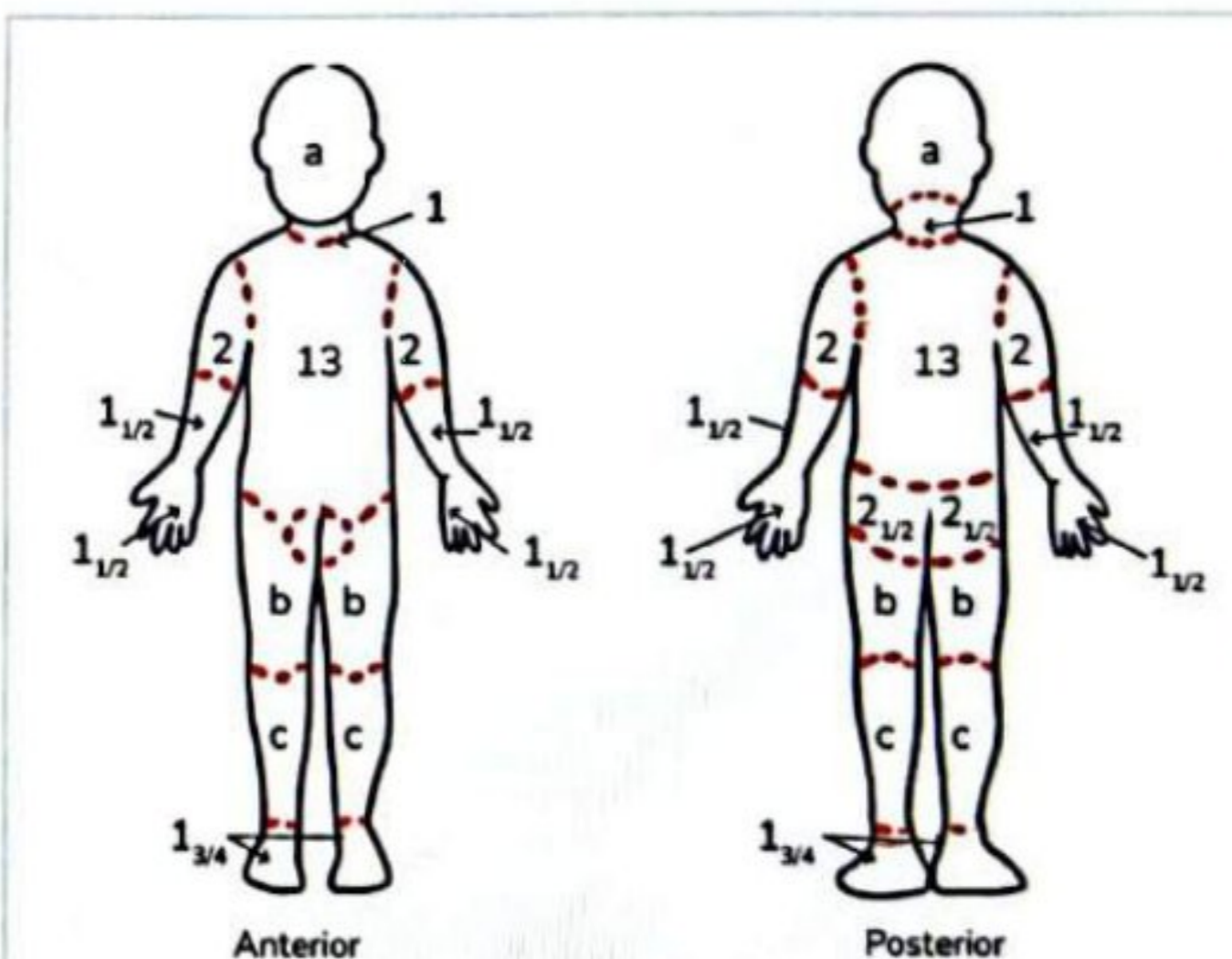
- It is a homicidal burn
- A method of homicide in South Africa.
- For killing, a tyre is used around and chest and an inflammable material.
- It is a burn Injury



- For total body surface area, **Rule of 9** also known as **Wallace rule** is used.
- 11×9 i.e., 99%.
- 1% is for genitalia and Perineal.

In adults,

- The head and neck is 9
- Upper limb is 9+9 (right and left)
- Chest is 9+9 (anterior and posterior)
- Abdomen is 9+9 (anterior and posterior)
- Lower limb is 9+9 for the right lower limb, and 9+9 for the left lower limb.
- In children's till infant age, modifications are there.
- The head and neck are big and are 18%.
- Lower limb is 13.5 for the right lower limb, and 13.5 for the left lower limb.



Relative percentage of body surface area (% BSA) affected by growth Age

Body Part	0 yr	1 yr	5 yr	10 yr	15 yr
a = 1/2 of head	9 1/2	8 1/2	6 1/2	5 1/2	4 1/2
b = 1/2 of 1 thigh	2 3/4	3 1/4	4	4 1/4	4 1/2
c = 1/2 of 1 lower leg	2 1/2	2 1/2	2 3/4	3	3 1/4

For children: Lund-browner's chart is used.

- 2, 1 1/2, 1 1/2 it is constant in every age (anterior and posterior)
- 13% for chest and abdomen

Body part	Age				
	0 yr	1-4 yr	5-9 yr	10-14 yr	15 yr onwards
a=1/2 of head	9 1/2	8 1/2	6 1/2	5 1/2	4 1/2
b=1/2 of 1 thigh	2 3/4	3 1/4	4	4 1/4	4 1/2
C=1/2 of 1 lower leg	2 1/2	2 1/2	2 3/4	3	3 1/4

Rule of palm

- It is used for patchy burns .
- Palm covers 1 % body surface area this is called rule of palm

Park-land formula -

- Crystalloid (Ringer lactate) fluid is given .
- 4 ml/ kg IV fluid is given (half of the fluid is given in 1st 8 hrs and remaining half is given in the next 16 hrs ,total duration is 24 hrs)

Cause of death (MCC)-

- Immediate -Asphyxia ,carbon monoxide intoxication,neurogenic shock
- Early- within 48 hrs hypovolemic shock, In 3-4 days acute renal failure
- Late- 4-5 days septic shock
- Overall- septic shock
- Bacteria -pseudomonas

PM finding -in burn cases

- Smell- kerosene/petroleum /chemicals
- Rigor mortis, livor mortis, Algor mortis -sometimes these are not appreciable
- Crowfeet sign -some area of the face will be spared from burn

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	Antemortem	Post -mortem
Lines of redness	Present	Absent
Vital Reaction	Present (both positive or negative)	Absent
Enzymatic reaction	Present (both positive or negative)	Absent
Blister	Albumin protein +chloride	Air +thin fluid
CO-HB	Elevated Level (more than 10%)	Normal level
Cyanide	Increased level	Normal level
Carbon particle /soot particle	carbon particle in trachea (most characteristic)	Absent
Curling ulcer	Most common site is 1st part of duodenum	Absent

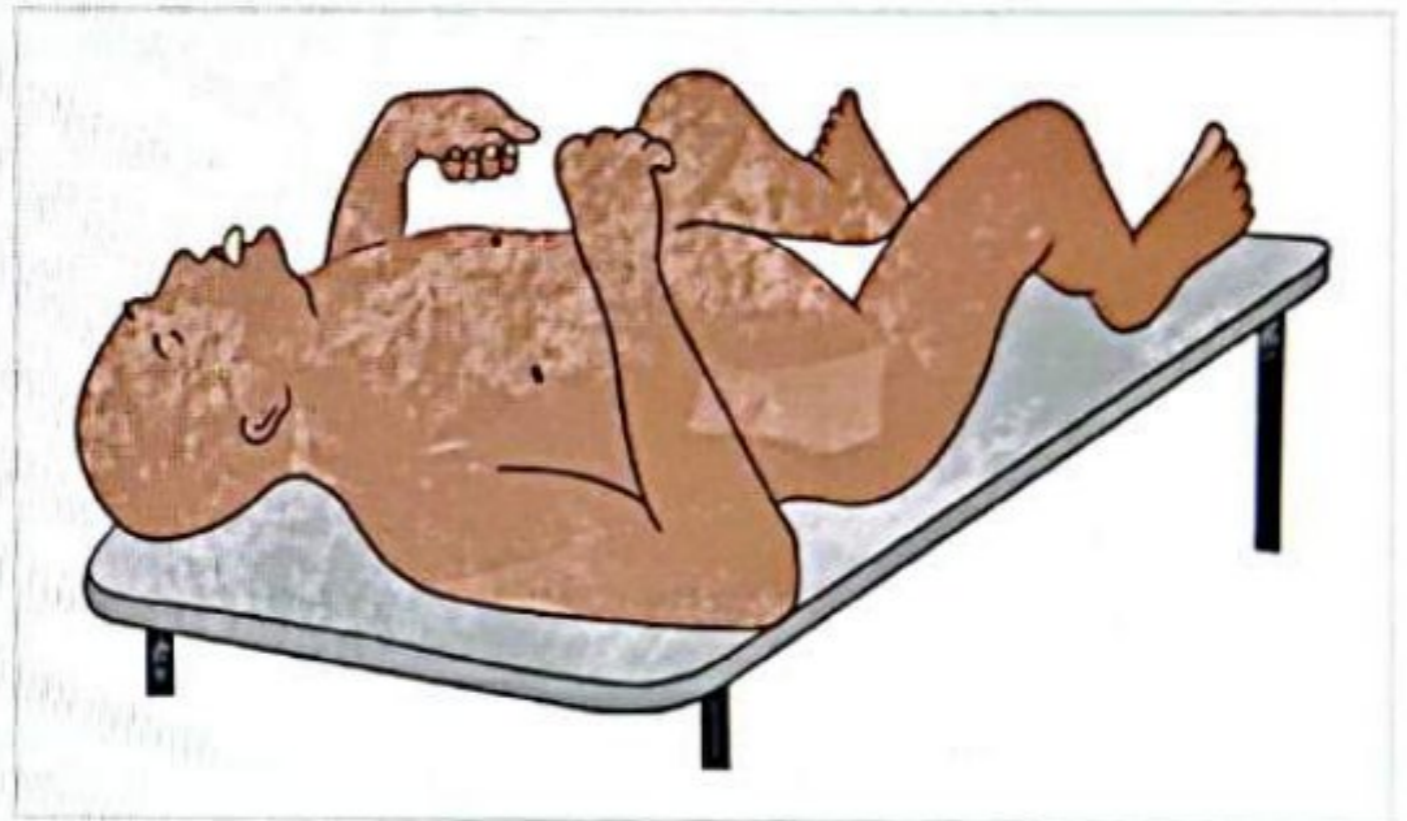
Non specific findings

01.04.28

- It can be found in antemortem and Postmortem and is caused by heat.

1. Pugilistic attitude

- It is also known as boxing attitude, fencing attitude, and heat stiffening.
- It is a contraction of muscles that causes a specific posture.
- It is seen when the temperature gets more than 65°C
- Above this temperature coagulation and denaturation of muscle protein occurs.
- It can be mistaken as the rigor mortis.



2. Heat Rupture

- It is mainly due to dehydration, coagulation of skin
- Skin and underlying tissues are ruptured.
- Extensor, fleshy, joint area is involved.
- Blood vessels and nerves are intact
- Bleeding, bruise, vital reactions are absent
- It can be mistaken as incised if it has a regular margin and it can be mistaken as lacerated if it has irregular margin.
- In incised and lacerated, the hair bulb will be crust and blood vessels and nerves will be crust and bleeding, bruise, vital reactions are absent.



3. Heat Hematoma

- It is seen in brain

- Mechanism- Dura contracted and blood excluded out from the venous sinus,
- It is above dura so it can be mistaken as an extradural or epidural hematoma.
- So to differentiate it -
 - It is chocolate brown in colour
 - It is showing a honeycomb appearance.

4. Heat fracture

- It is also known as thermal fracture and is seen in skull and long bones
- If it is seen in long bones it is street Avenue fracture.
- Mechanism: Dehydration or drying of the bones or skin. Because of this skull will burst and when the skull will burst this will be skull fracture.
- It can be mistaken as a traumatic fracture.
- This thermal fracture can cross the suture line but does not involve the suture line.

5. Puppet organs

- The internal organ of the body shrunken, firm, and fixed due to extreme heat.

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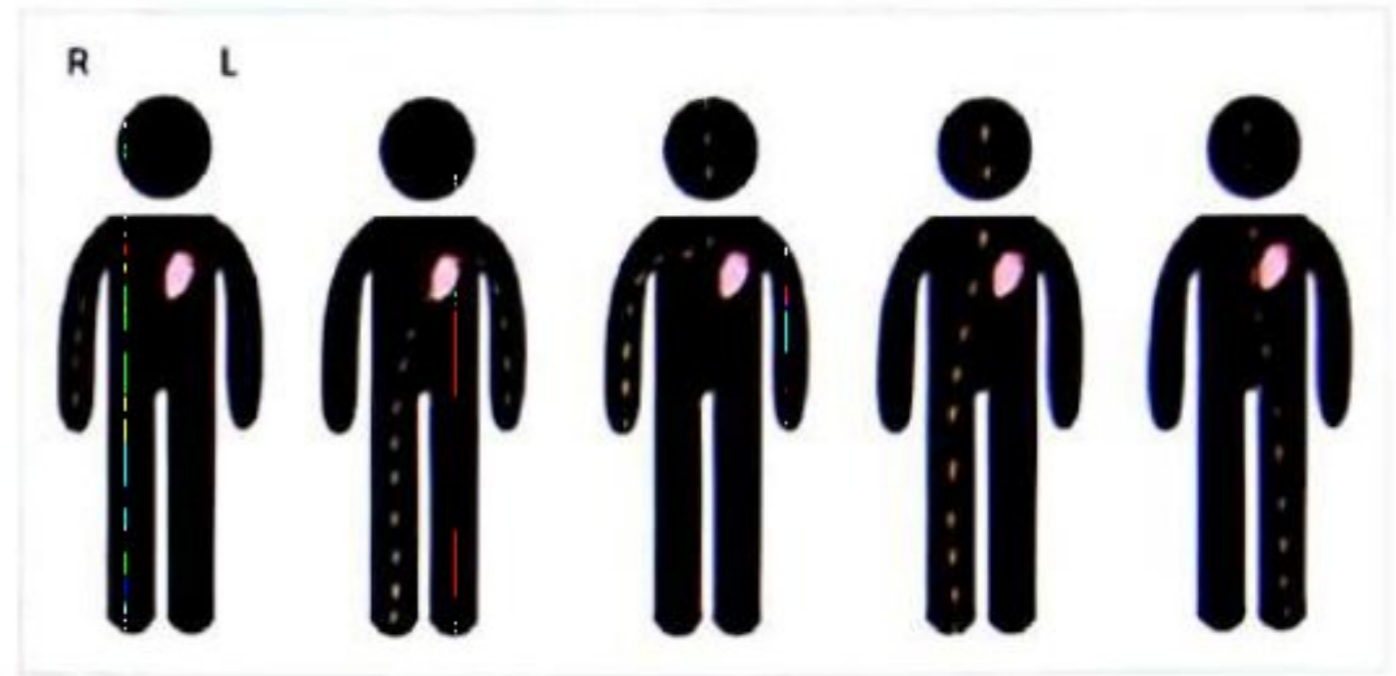
Electrocution: (electric shock)

01.15.03

- It is mostly accidental and sometimes it can be homicidal or suicidal.
- Judicial electrocution seen in some states of the USA.
- Alternating current (AC) is more dangerous than direct current (DC) (4 to 5 times) because it causes tetanic contraction.
- The fatality of electrocution or the number of injuries of electrocution is directly proportional to the voltage and amperage. (Amperage is more important). Holding on spasm (tetanic spasm) will cause more injury.
- Resistance is inversely proportional to fatality or injury.

Cause of death

- Electrocution most commonly passes through the heart and causes ventricular fibrillation and cardiac arrhythmia.
- If it passes through the brain stem it will cause respiratory failure.
- If it passes through the diaphragm it will again cause muscle contraction and respiratory failure.
- Most resistant tissue is dry skin then bone and then moist skin.
- Electrocution has an entry and exit point, it claims to be the most dangerous circuit when the entry point is the right hand and exit point is the left foot.
- Point of contact is entry
- Point of grounding is exit



1. If the point of contact is the right side and the point of grounding is the left side, it affects the heart.
2. If the point of contact is the left side and the point of grounding is the right side it will also affect the heart.
3. If the point of contact is the upper part and the point of grounding is the right hand it will affect the brain stem.
4. If the point of contact is the upper part and the point of grounding is the right foot it will also affect the brain stem.
5. If the point of contact is the upper part and the point of grounding is the left foot it will affect the brain stem and the heart.

Postmortem finding

- Rigor mortis comes early
- Local haemorrhages and tears of muscles.
- Pit-like defects in the superficial surface of hair because of arching of current.
- Due to electrodes or wire the molten metal that is the current pearl goes deep into the soft tissue.
- Molten calcium phosphate from bone called bone pearls or wax drippings are detected in radiological investigations.
- When electricity goes in muscles it causes rhabdomyolysis and myoglobinuria.

Electric mark (Joule burn)

- It is seen in low voltage electrocution and with firm contact.
- It is an entry wound seen at the site of entry.
- It is known as joule burn. After touching wire, electricity goes inside the body and heat is produced in the body and because of the heat it is an endogenous burn.
- It can be of oval shape or round shape.
- It is like a crater, the central area is depressed or compressed and the peripheral area is raised, it is pale and areola.
- Mechanism is coagulation of dermis and elongation of epidermal cells.



Loose contact with air gap:

- It produces an exogenous burn known as flash burn or spark. (Patchy area)

Loose contact with high voltage:

- It is an arc dancing
- It produces multiple pitted/punched out burns known as crocodile flash burns. (Circulated area)



- It is known as keraunographic marking
- It is known as filigree burn.
- It is also known as arborescent marking and lichtenberg margin.
- It is a ferning pattern and is of pink colour.
- It has an erythematous and branching tree pattern (ferning).
- Its mechanism is denaturation of RBC which causes haemoglobin staining of the blood.
- It is seen upto 24 hours.
- The most common site is shoulder flings and abdomen folds.
- Difference from marbling:
 - Marbling is of green colour, and it is a vascular distension.
 - It corresponds to the vascular channels or vessels.

Spencer theory of lightning

1. Direct effect is because of high voltage
2. Superheated air of lightning produces burn
3. Expanded and compressed air.
4. Sledge-hammer effect: Air is compressed in front of lightning injury.

Lightning injuries

01:33:50

Lightning can hit directly, from side, indirectly.

**Other injuries or effect from lightning**

- It is an electric discharge from clouds.
- It is mainly direct current but is more dangerous because this direct current has high voltage.
- It is accidental

- Flame effect: burn on the body
- Blunt trauma: Heat Injury or other organ injury.



Table 13.1

Heat cramp	Heat exhaustion	Heat stroke
<p>It is also known as a miner's cramp or fireman's cramp</p>	<p>It is also known as heat syncope or heat prostration</p>	<p>It is also known as sunstroke or thermic fever or heat hyperpyrexia</p>
<p>If there will be excessive heat outside, there will be a loss of electrolytes (sodium and potassium) and water, Because of this there will be muscle cramps in the hands, legs, and abdomen.</p> <p><small>prince kumar princeekum@gmail.com 9928609733</small></p>	<p>In more heat sweating increases and there will be a loss of electrolytes and fluid (because of this there will be decreased venous return and it will cause decreased cerebral Perfusion)</p>	<p>It is common; if you are working in sunlight, if you have increased muscle activity, if you have some infection, and if you have a very humid temperature. If your body temperature goes above 104°F /40.5° C, in this case, your sweating will stop and you will get a heat stroke.</p>
<p>It is common in people working in miners and fire industries.</p>	<ul style="list-style-type: none"> • Clinical - Fainting, dizziness, and lightheadedness. • CBT-normal • Pupil -will be dilated • Skin -cold and moist • Cause of death is vascular collapse or syncope. 	<ul style="list-style-type: none"> • Mechanism -thermo regulatory center stopped and the hypothalamus stopped working. • Clinical -altered mental status, disorientation, loss of consciousness • CBT- is high (thermic fever) • Pupil -constricted • Skin -dry and hot skin • Sweating -stopped (anhidrosis).
<p>Treatment -fluids, and electrolytes are given.</p>	<p>Treatment -fluid therapy and elevation of the leg to increase the venous return.</p>	<p>Treatment -remove the clothes, bath with ice water, ice pack, and oral and IV fluid, and use AC and fan to decrease the temperature.</p>



- Injuries caused by
 - Mechanical pressure.
 - Mechanical trauma.
 - Mechanical friction.
- Injury under 44 IPC, any illegal harm to
 - Body
 - Mind
 - Reputation or property
- **Wound** is a breach of the natural continuity of either skin or mucous membrane.

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Classification of Mechanical Injuries

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- Due to blunt force (stone, hammer, or heavy objects)
 - Abrasion
 - Contusion
 - Laceration
 - Fractures or dislocations
- Due to sharp force (knife, blade, sword, ax)
 - Incision
 - Stab (pointed objects)
 - Chop (axe) may also fall under laceration.

A. Due to Blunt Force (Stone, Hammer or Heavy Objects)

a. Abrasion

- Most **common** mechanical injury.
- **High** medico-legal importance.
- Loss of epidermis (**scrapping** of epithelium)

Recall

319 IPC section - that comes under simple hurt

- Abrasion is a simple injury.
- No active bleeding
- No scar

Golden Points

- Corneal abrasion causes corneal opacity (visual restriction)
- Under 320 IPC it is a Grievous hurt

Abrasion force

- **Tangential force**, along the epidermal layer
 - Scratch abrasion
 - Grazed abrasion
- **Perpendicular force**, perpendicular to the epidermal layer
 - Pressure abrasion
 - Imprint abrasion

Scratch Abrasion



- **Scratch abrasion**
 - It is a line
 - Also known as **Linear abrasion**.
 - It is by tangential force.
 - Length is **good**.
 - Width **not significant**.
 - **Examples**
 - Fingernail abrasion
 - Thorne abrasion
 - Pin abrasion
- **Grazed abrasion**
 - It is by **sliding** on rough surfaces (roads)
 - Most **common** road traffic accidents
 - **Also known as**
 - Grinding abrasion
 - Grave rash
 - Brush-burn
 - Sliding abrasion



- **Pressure or Crushing abrasion.**

- Continuous pressure causes the **crushing of the epidermis.**
- Force is perpendicular (90°) to the epidermis.
- There may be **chances of Contusion** also.
- **Examples**
 - Ligature mark (hanging and strangulation)
 - Bite mark



- **Imprint abrasion**

- Also known as
 - Impact abrasion
 - Contact abrasion.
 - Patterned abrasion.
- **Forms pattern** of object or weapon
- Perpendicular force but is caused by a rough object with an **irregular surface.**
- **Examples**
 - Tyre marks
 - Patterned Ligature mark.

Golden point: In most cases, ligature marks are pressure abrasions



The direction of the force

- **End** of abrasion have
 - Multiple lines
 - Uneven lines
 - Longitudinal lines
 - Lines are heaped up or aggregated.
 - Also known as Epithelial tag
- **Direction** of abrasions is identified by endpoints easily.

Duration of abrasion

- **Age** of abrasion can be identified by the color the of scab.
- Scab is a **dry blood or lymph exudates** after an abrasion.
- Color of scab
 - Bright red scab: 12-24 hours (>12 hours)
 - Reddish brown scab: 2-3 days
 - Brown scab: 4-5 days
 - Black scab: 6-7 days
- Before 12 hours **no scab** is seen.
- After 7 days the scab **falls.**
- Abrasion gives an idea for **suspected crime/manner of death.**
- **Example,**
 - Throttling: Crescentric fingernail abrasion.
 - Sexual assault: Genital abrasion.
 - Smothering: Perioral abrasion.
 - Tyre mark

Differential Diagnosis of abrasions

- Ant erosion
- Excoriation surrounding the anal canal.
- Pressure sore
- Dry skin
- Postmortem Abrasion

Postmortem Abrasion vs Antemortem abrasion

Feature	Postmortem abrasion	Antemortem abrasion
Intra-vital reaction or congestion	Present	Absent
Site	Any site	Bony prominences
Color of abrasion	Yellowish white	Color changes
Scab	Less raised	Raised
Exudates	Less	High

b. Contusion

- Also known as **Bruise**
- Injury to the **dermis**
- Dermal blood vessels are **ruptured** which clots blood.
- Due to this **extravasation**, swelling or raised area is seen.
- Force caused by **blunt objects.**
- Contusion has extravasation or swelling known as a bruise.
- Margins are **irregular.**
- **Stomping** (kicking and jumping) is seen.



- Color changes
- **Hematoma** is seen by dissection of the skin.

Factors

- **Site**
 - **Vascular and loose area**
 - face, vulva, eyelid, and scrotum
 - Impact, force, trauma smaller
 - Size of the contusion is bigger.
 - **Bony prominences**
 - Impact, force, trauma smaller
 - Size of the contusion is bigger.
 - **Thick skin**
 - Palm and sole or abdomen
 - Impact is bigger.
 - Size of the contusion is smaller.
- **Age**
 - **Children and old persons**
 - Size is bigger.
 - Delicate skin or subcutaneous tissue
 - Relaxed skin
- **Sex**
 - Females have more **relaxed or delicate skin** or subcutaneous tissue
 - Size of the contusion is **bigger**.
- **Complexion**
 - **In whites**
 - Bruise is seen easily.
 - Color changes easily.

Age of Bruise

- Blunt object moves the blood to the **periphery**.
- Color changes of the bruise starts from the **periphery to the center**.
- **Colors**
 - Red, fresh color of contusion (1-2 hours)
 - Violet+Indigo: Blue (Deoxygemoglobin, few hours-3 days)
 - Brown (Hemosiderin, 4th day)
 - Green (Biliverdin, 5-6 days)
 - Yellow (Bilirubin, 7-13 days)
 - Original color, seen after 2 weeks.
- No color changes due to **Oxyhemoglobin**
 - Subconjunctival hemorrhage (oxygen supply is provided).
 - Meningeal hemorrhage (oxygen supply is provided).

Feature	Bruise	Hypostasis (Postmortem staining)
Site	Any site with trauma	Dependent parts of the body
Cause	Trauma	Postmortem changes
Color change	Present	Absent, generally bluish white
Margins	Irregular	Regular
Extravasation	Present	Absent
Blanching	Absent	Present
Incision test	Not washed away	Washed away

Golden Points

- **Blanching:** Become colorless when pressure is applied.
- **Incision test,** pour water into the incision on the skin.
 - Bruise has clotted blood, it is not washed away.
 - Hypostasis has blood in blood vessels, it is washed away.

Ectopic Bruise

- Also known as **Migratory Bruise**
- Trauma is at a different site, and the bruise is at a different site.
- **Example:** In an Anterior cranial fossa fracture bruise is periorbital or periorcular



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- Causes **Raccoon sign** or **Black eye** or **spectacle hemorrhage**.
- In a Middle cranial fossa fracture bruise is at the mastoid tip or posterior auricular area.

Battle Sign



- Causes **Battle sign**.

Patterned Bruise

- Forms **object pattern**
- Lathi/rod/stick forms **Tramline/Rail line bruise**
- Pinching forms a **Butterfly bruise**.

Recall: Battered Baby Syndrome (BBS) forms Butterfly bruises and six-penny bruise.

- Throttling with finger-tip pulp forms **Coin shaped bruise (Six penny bruise)**



Artificial Bruise

- **Criminals** may produce bruises artificially.
- By harming **themselves**.
- Products used to harm.
 - Plumbago
 - Semicarpus Anacardium (Marking nut)
 - Madar/ Calotropis

Differential Diagnosis of Artificial Bruise

- **Site:** Accessible parts
- **Margin:** Regular or well-defined.
- **Shape:** may be irregular
- **Content:** Acrid serum, redness, inflammation
- Blister with itching
- Chemical test positive for a chemical present in the object used.

Come-out Bruise

- **Other names**
 - Delayed bruise
 - Percolated bruise
- Extravasation in deep tissues **comes out within 1-2 days**.
- Even **after death** delayed bruising is seen.
- **Infrared photography** is used to diagnose a delayed bruise

Golden Points

- Bruise/contusion is not medicolegally significant.
- Size is not well defined.
- Delayed bruise may be seen.
- Color may not be confirmed always.
- Age of the bruise is not clear
- In Ectopic bruises, trauma, and bruises are at different sites

c. Laceration

- Also known as **Tear**
- **Trauma:** **Blunt** trauma, may be **heavy**
- **Damage:** 3-Dimensional injury
 - Length
 - Width
 - Depth
- **Margins:** **irregular**
- **Floor:** vessels, nerve, and hair bulb are **crushed**.
- **Structures:** Epidermis + dermis + subcutaneous tissue.
- Swallow tail, tearing at the end, **diverging**.
- **Tissue bridges** and tissue fragments connect each other from the margin.
- Bleeding comparatively **less** due to crushed blood vessels.

Golden point: Bleeding is more in incision

Types of Laceration

1. Split Laceration

- Also known as **Incised looking laceration**.
- Seen on the **hard surface** of the body.
 - Skin is attached to the bone.
 - Less subcutaneous tissue
 - **Example**
 - Scalp
 - Forehead
 - Eyebrow
 - Chin
 - Zygoma
 - Shin (Pretibial region)
 - Iliac crest
 - Perineum
 - Posterior part of the elbow
- **Margin:** Clean cut, regular when observed with **naked eyes**.

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Note: Don't ever examine injury with the naked eyes

- **Magnifying lens: (differentiate from an incision)**

- Crushed tissue and **Crushed hair bulb**.
- Bleeding is less.
- Tissue bridges

2. Avulsion

- Also known as **Shearing laceration**
- It is a kind of **separation** when a lorry wheel run over a limb in run-over injuries).
- Detach of tissue: **Acute angle**
- 2 Categories are seen.
 - **Flaying**
 - Large area is detached.
 - But one point is connected to the surface (skin or subcutaneous tissue)
 - **Degloving**
 - Skin or subcutaneous tissue comes out from the limb.
 - Like a glove



3. Stretch Laceration

- **Force:** Tangential force
- Due to overstretching of the skin or subcutaneous tissue which is **fixed**.
- Forms a **Flap (tearing)**
- **Commonly** seen in compound fracture, a bony fragment comes out.
- A motor vehicle running over.
- Kicking with the boot forms a flap (tearing)

4. Cut Laceration

- Cut is caused by a **sharp weapon**.
- Laceration is caused by **blunt weapons**.
- **Weapon:** Sharp-ended, heavy
 - Axe
 - Hatchet
 - Chopper
- It is a **cross** between an incision and a laceration.
- Edges of weapon: sharp, heavy.
- Cut the skin and tissue.
- **Margin:** crushed (heavy weapon), bruised (contusion).
- Crushed tissue and hair bulb seen.

Golden point: Tissues are cut and crushed

- Underlying bones are **fractured**.
- Gaping is more, known as **Chop wound**.



Chop wound with an axe.

- Heel (lower) end strikes first.
 - Depth of the wound is more.
- Toe end strikes first.
 - Depth of the wound is less.
- **Direction and force** of the weapon can be determined.
- Gaping is **more**.
- These can be always **homicide** in nature.

5. Tear

- Most **common** type of laceration
- By any **irregular hard surface**
 - Door handle of the car
- It can be on the **skin or viscous**.

B. Due to Sharp Force (Knife, Blade, Sword, Axe)

a. Incision

- Also known as **Cut injury**.
- **Weapon:** Sharp edged, parallel to skin surface.
 - Knife
 - Blade
- Maximum dimension: **length > breadth > depth**.
- **Margin:** Clean cut, regular by the naked eye.
- Magnifying lens used to see structures cut not crushed.
 - Vessels
 - Nerves
 - Hair bulb
- Hemorrhage/ bleeding is **profuse**.

Recall: Split laceration looks like an incision.

- Laceration-looking incised wounds in loose skin or tissue area.
 - Axilla
 - Scrotum
- When a sharp object is applied, these loose surfaces produce **irregular margins**.
- Without a magnifying lens, it **looks like a laceration**.

Phenomenon involved in an Incised wounds.

1. Tailing

- Important phenomenon
- Deep at the beginning, shallow (superficial) the at end
- Importance: direction of the weapon

2. Beveling

- **Obliquely strike.**
- **Undermined edges** are known as beveling.
- Importance: position of assailant and victim
- Common in genitalia (homicide)
- Medicolegally significant

Incised Wound (with Tailing)



Age of Incised Wound

- **Fresh:** Hematoma
- **12 hours:** Edges-red, swollen.
- **24 hours**
 - Endothelial cells cover edges and margins and forms scabs.
 - Vascular bud begins.
- **36 hours:** Capillary network completed.
- **48-72 hours**
 - Fibroblasts are seen in the wounds.
 - Capillary bud comes inside.
- **3-5 days**
 - Fibrils are seen.
 - Collagen fibers are seen.
 - Vessels are thickened and obliterated.
- **1-2 weeks:** Formation of scar

Self-Inflicted Suicidal Wound

- Found in **inaccessible parts.**
 - Forearm (wrist)
 - Neck
 - Abdomen
- **Suicidal** in nature
- Multiple, uniform in size and depth.
- **Parallel lines**
- Mostly **superficial** wounds.
- Deep wounds cause **death.**
- Also known as

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- Hesitational cut.
- Trail cut.
- Tentative cut
- Mainly **incised wounds.**

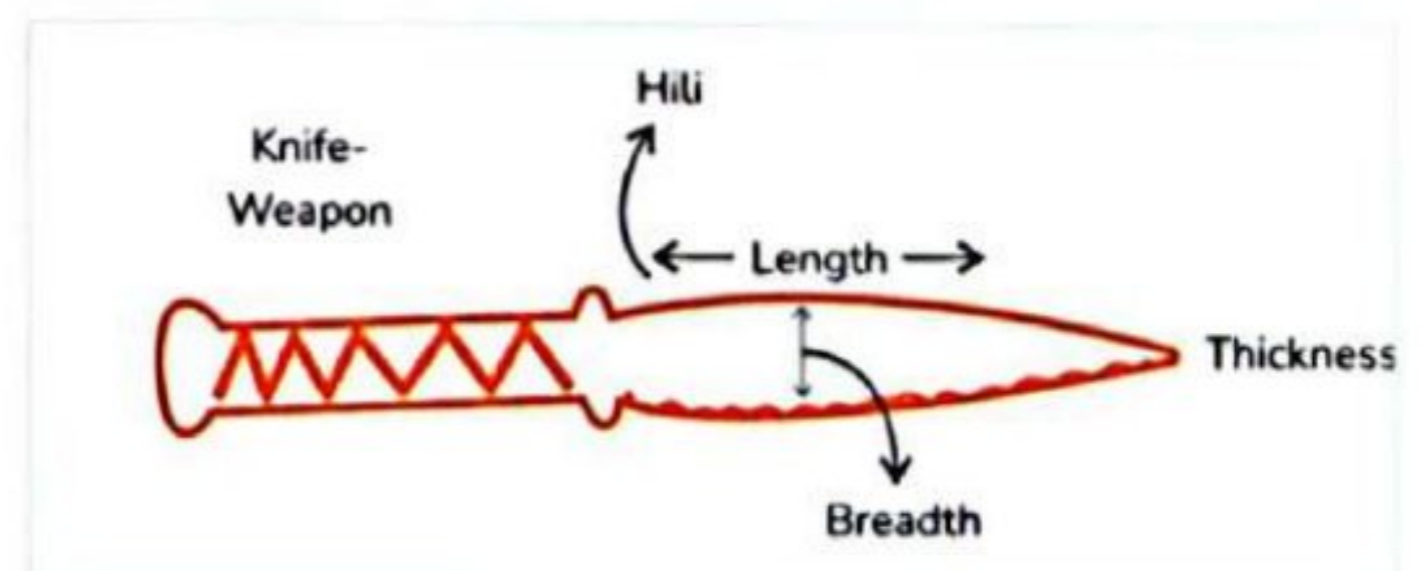
Self Inflicted Incised Wound



b. Stab Wound

- **Weapon:** Sharp-edged, pointed.
 - Knife
 - Sword
- **Perpendicular** to the epidermal layer.
- Maximum dimension: Depth
- **3 types**
 - **Puncture:** Stab on tissue or skin
 - **Penetrating:** Thoracic or abdominal cavities
 - Most common Liver damage is seen.
 - Only entry wound is seen.
 - No exit wound.
 - Withdrawal may cause taling (superficial damage to less depth side)
 - **Perforating:** Through and through
 - Entry and exit wounds are seen.
 - Entry wound is large with inverted margin.
 - Exit wound is small with everted margin.

Knife



• Parts

- Handle
- Hilt
- Blade (metallic part)

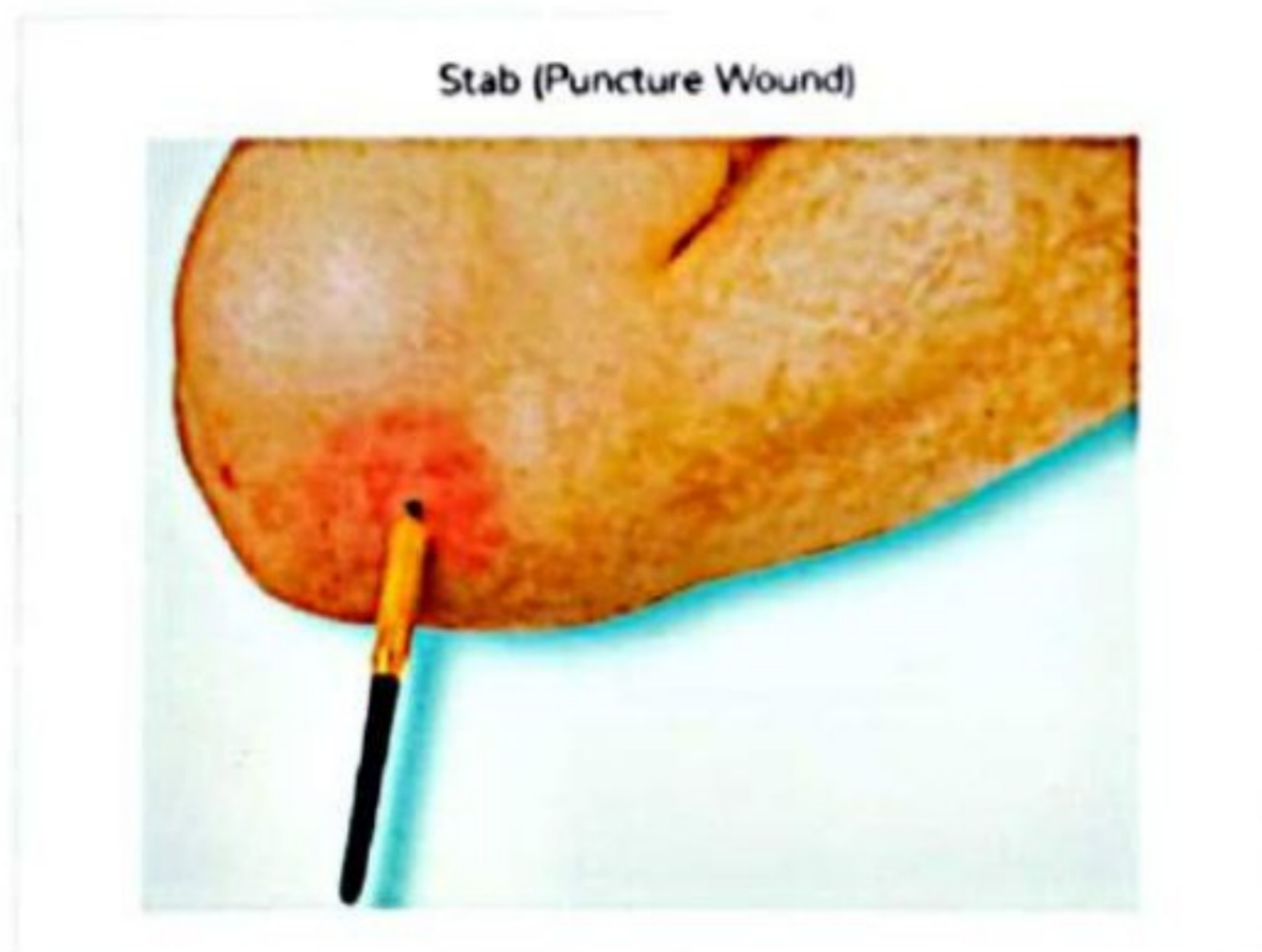
- **Dimensions of knife**
 - Length
 - Breadth
 - Thickness
- If the knife enters the body, the **maximum dimension is depth**.
- **Depth** of injury is approximately equal to the length of the weapon.
- **Length** of the injury is slightly lesser than the breadth of the weapon.
- This is due to **skin stretching**.
- **Thickness** of the weapon is equal to the breadth or width of the injury.

The shape of the Stab Injury

Feature	Single edged weapon	Double edged weapon
Sharpness	One side sharp, one side blunt	Both sides sharp
Shape of injury	Triangle/wedge Tear drop. Fishtailing	Spindle Oval

Golden Points

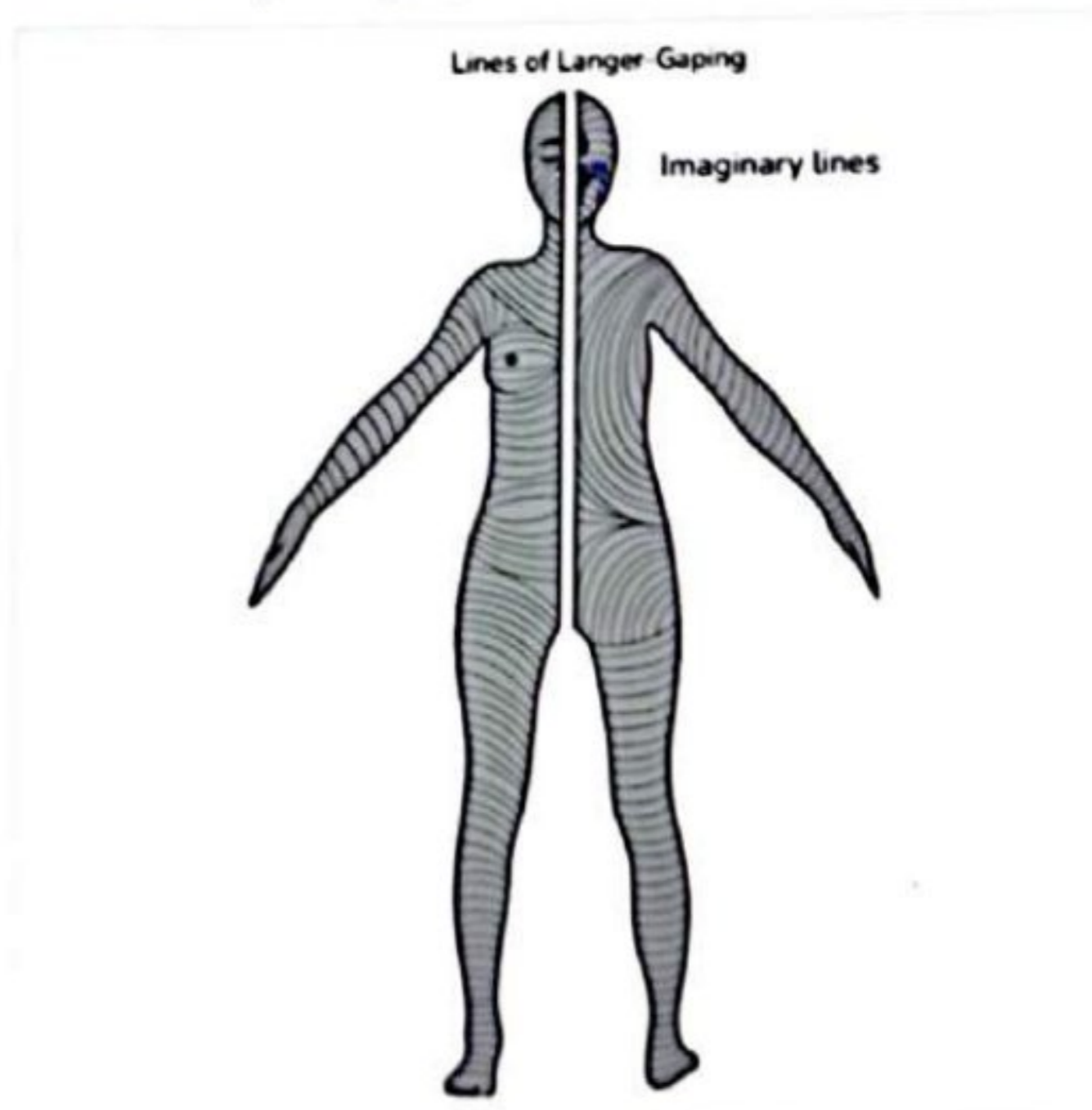
- In Fish-Tailing, formation of the tail due to the splitting of the skin
- This splitting is by a blunt edge



Golden points

- If Hilt is present in the weapon and completely penetrates the body, it causes damage.
- **Other name**
 - Hilt abrasion
 - Hilt contusion
 - Hilt laceration

Lines of Langer-Gaping



- **Imaginary lines**
- Corresponding to **collagen fibers** of the body
- Gives an idea about the **gaping** of the body.
 - If stab injury is parallel to these lines, then gaping would be less.
 - If stab injury is perpendicular to these lines, then gaping would be more.
- Collagen fibers are cut in **perpendicular** injury.
- Collagen fibers are not cut in **parallel** injury.
- Lines of Langer gives **shape and size of the injury**.

Hara-kiri

- Also known as **Seppuku**
- Common in **Japan**
- It is a **stab** injury.
- Sword or long-handled knife is used to commit **suicide**.
- Sword is **hit** in the **abdomen**.
- Intra-abdominal pressure (**IAP**) becomes very low.
- **Evisceration** (viscera comes out)
- Leads to **cardiac collapse**.
- **Syncope/hypotension** is seen.

Concealed puncture wounds

- Concealed parts of the body
 - Nostrils
 - Fontanelle
 - Axilla
 - Vagina
 - Rectum/anal canal
 - Inner canthus of the eye
 - Nape of the neck (pithing)

Recall: Stomping (kicking and jumping) on the body is seen in Contusion

- **Gross examination or Meticulous postmortem examination** is to be done.

Defense wounds

01:48:00

- Caused during **defending**.
- 2 types
- 1. **Active**
 - Most common site is the **Palmar** surface.
 - Grasp
 - 1st web space
- 2. **Passive**
 - Most common site is.
 - **Medial or ulnar** aspect of the forearm
 - Extensor aspect of forearm or wrist
- **Medicolegal importance:** Homicide

Golden Points

- Defense wounds are not seen.
 - Back
 - Unconsciousness

Fabricated Wounds

- **Self-inflicted**
 - Self-harm to the body.
- **Self-suffered**
 - Taking the help of others to hit your body.
 - Very potential

Differential Diagnosis of Fabricated wounds

- **Motive** is present.
- **Discrepancy** between injuries in the body and history given.
- Defense wound is **absent**.
- **Accessible parts** of the body
- **Cloths** not involved.

Overkilling

- **Massive, Multiple injuries** on the body
- Due to **anger, rage**
- Injury required **more** than causing death.
- **Example:** Stabbing 15 times, in which stabbing less than 15 times is enough to cause death.



PREVIOUS YEAR QUESTIONS



Q. Rupture of the skin and subcutaneous tissue is prince kumar
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(FMGE May 2018)

- A. Incised wound
- B. Abrasion
- C. **Lacerated wound**
- D. Contusion

Q. A dead body with a wound on the neck with clean cut edges, crushed tissues with disrupted vertebra body portions. Identify the type of the wound? (FMGE Aug 2020)

- A. Cut wound
- B. **Chop wound**
- C. Laceration
- D. Avulsion



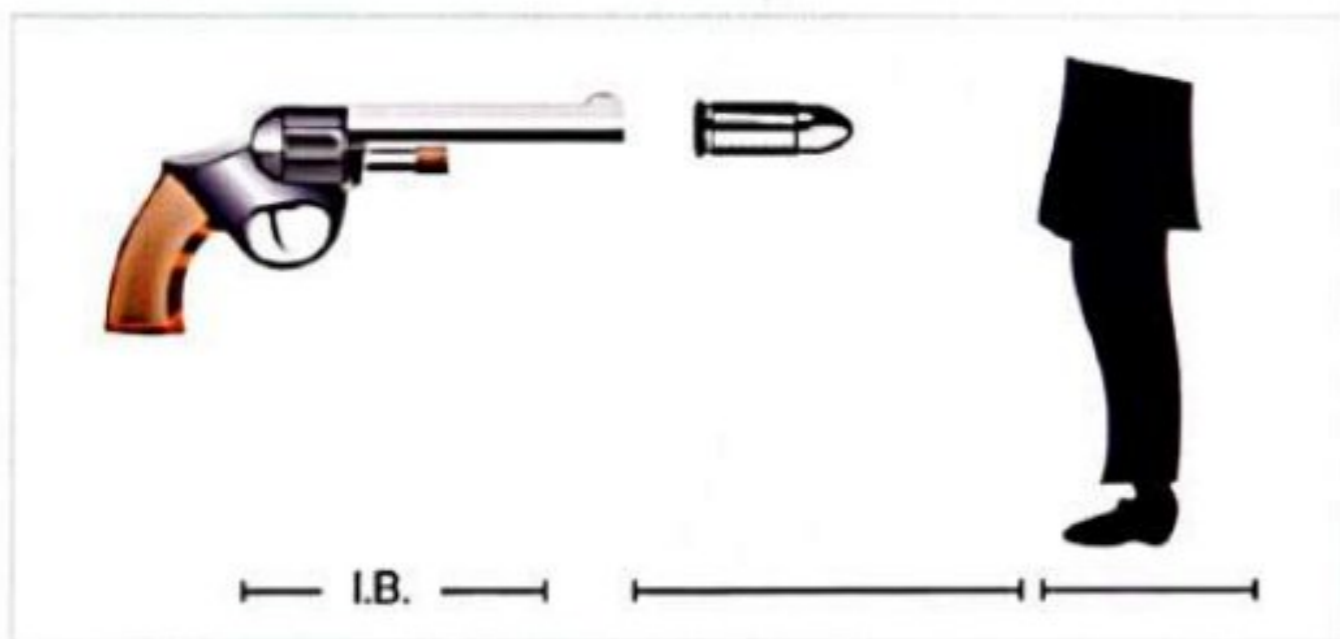
Firearm(ballistics)

- **Father of ballistics- Calvin Goddard**
- **Projectile motion:** Ballistics is a study of projectile motion. Anything which comes out from firearms. Examples- Bullets, lead shot.
- Firearm- weapon
- Ammunition- bullet, explosive material
- Problem- wound.
- All these three things are called forensic ballistics.

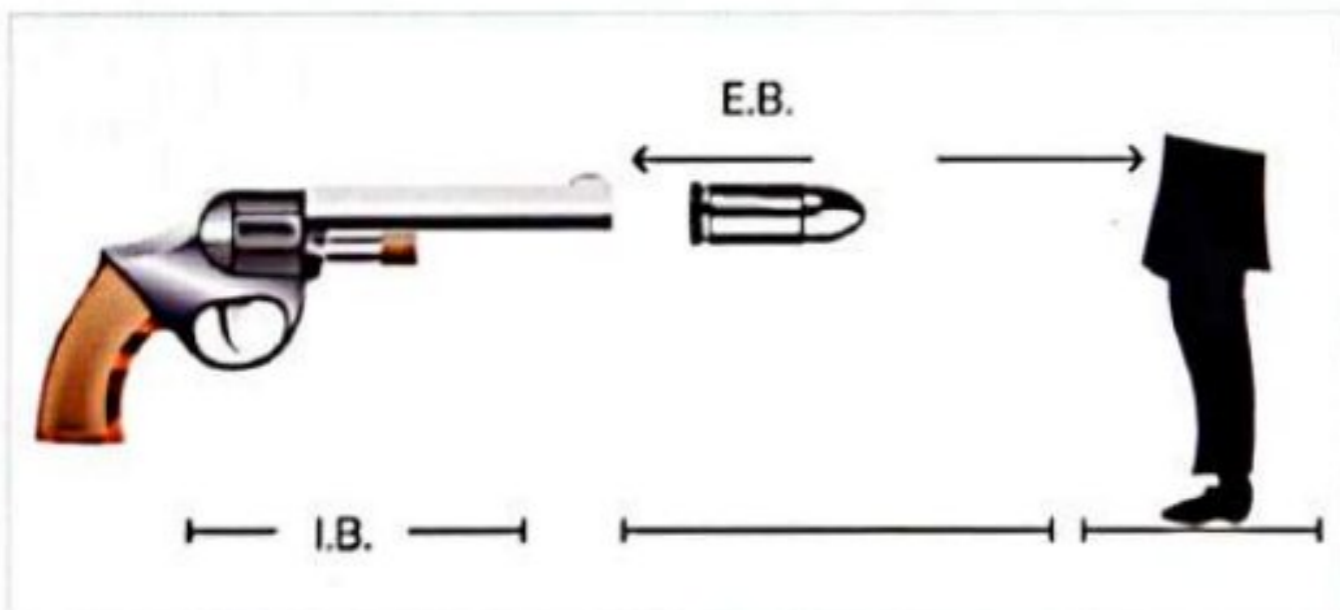
Classification of Ballistics:

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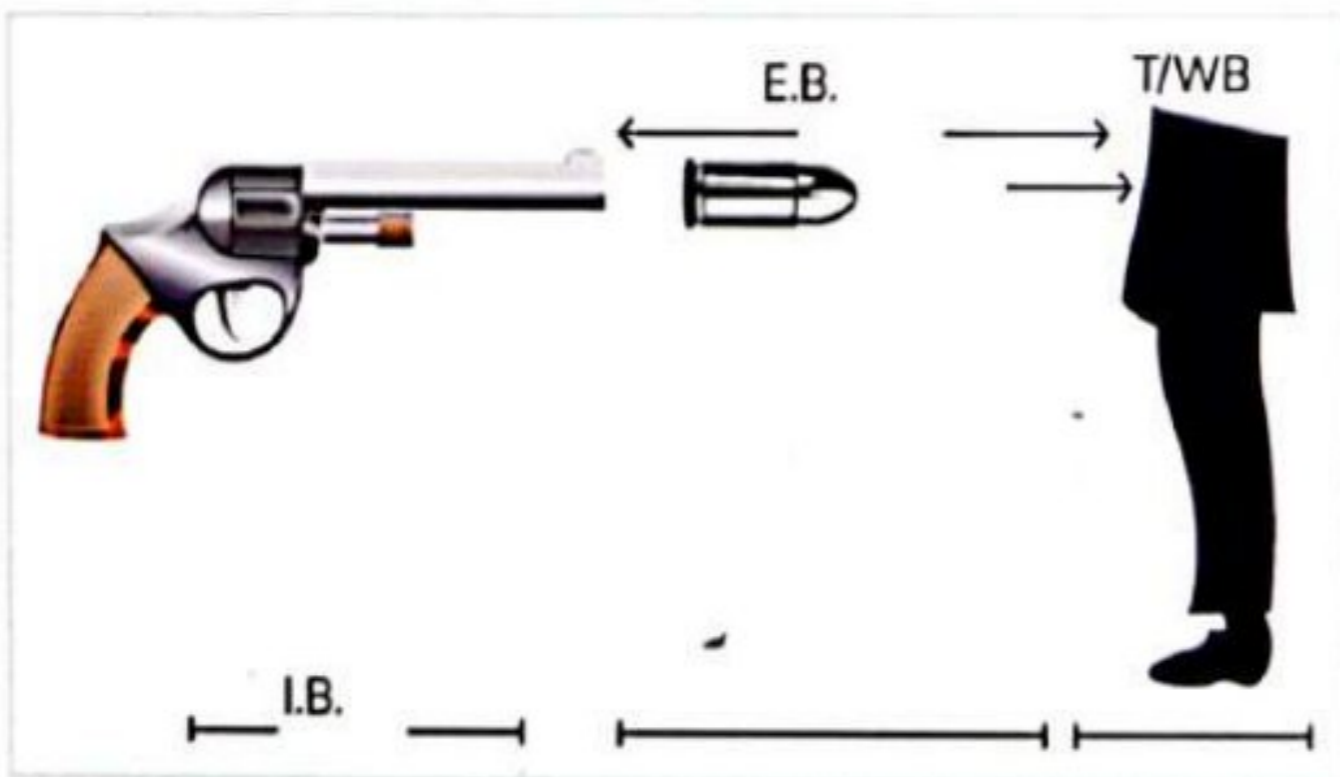
- **Proximal (internal) Ballistic:** Study of the projectile in firearm weapon.



- **Intermediate(exterior) Ballistic:** Study of the motion of projectile gun barrel till the time it hits the target.

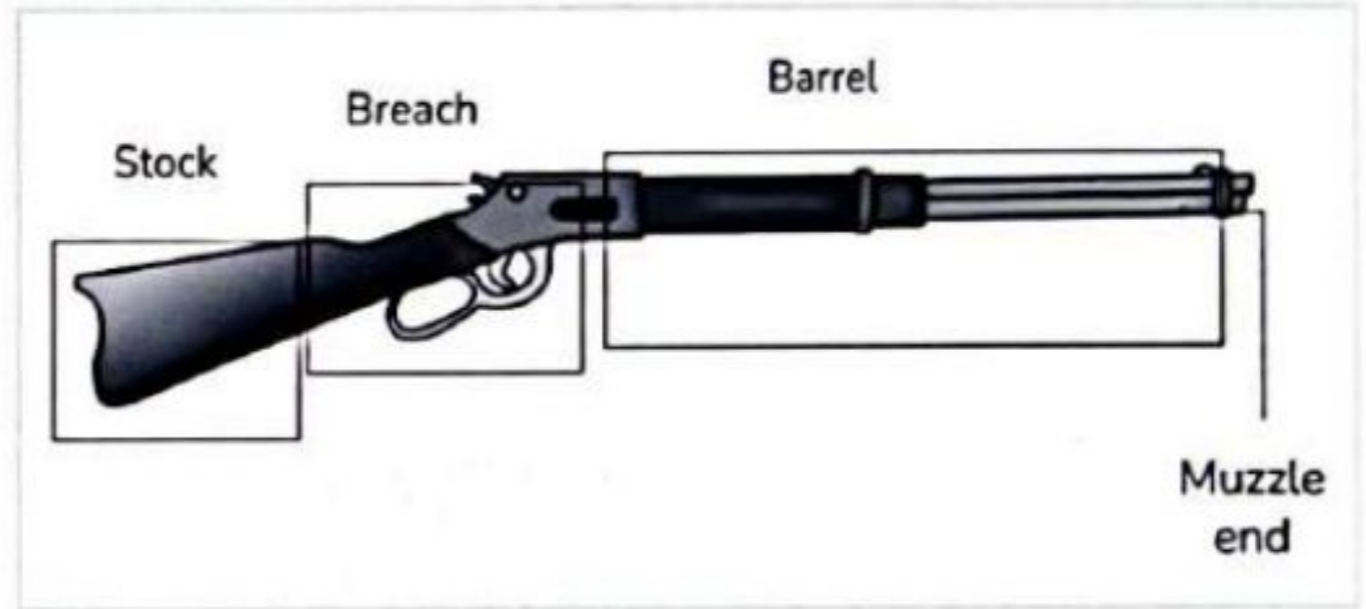


- **Terminal Ballistics:** Penetrate the target.
- **Wound Ballistic:** Penetrate in living tissue.



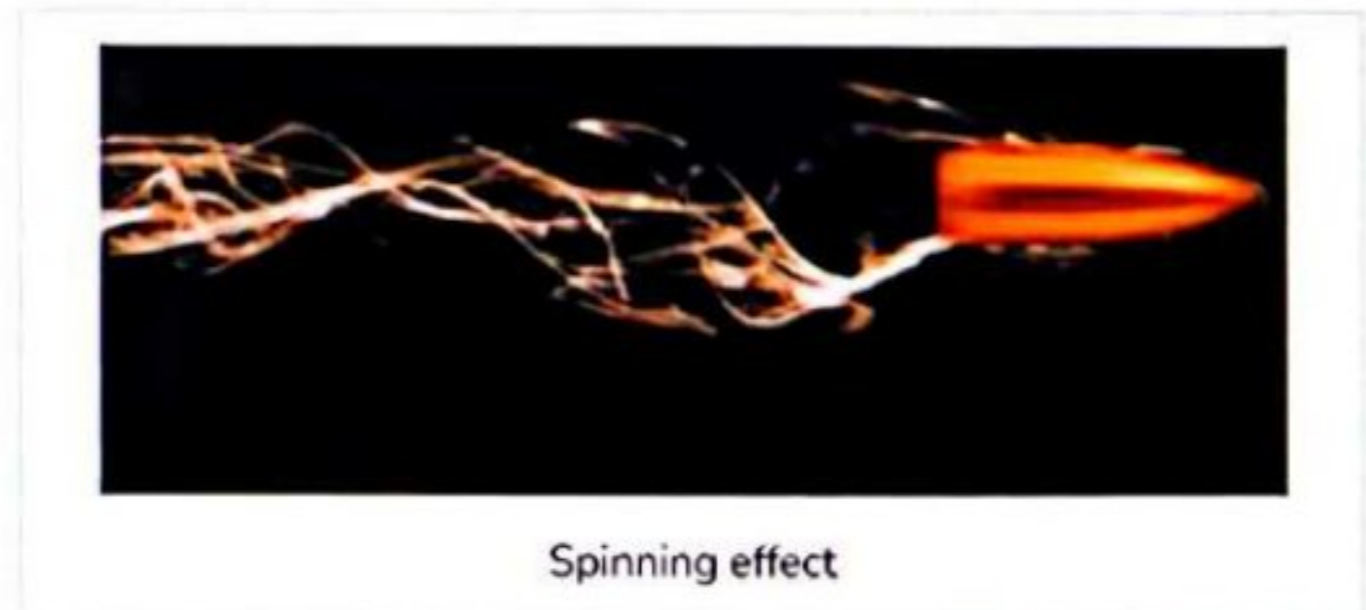
Classification of Firearm:

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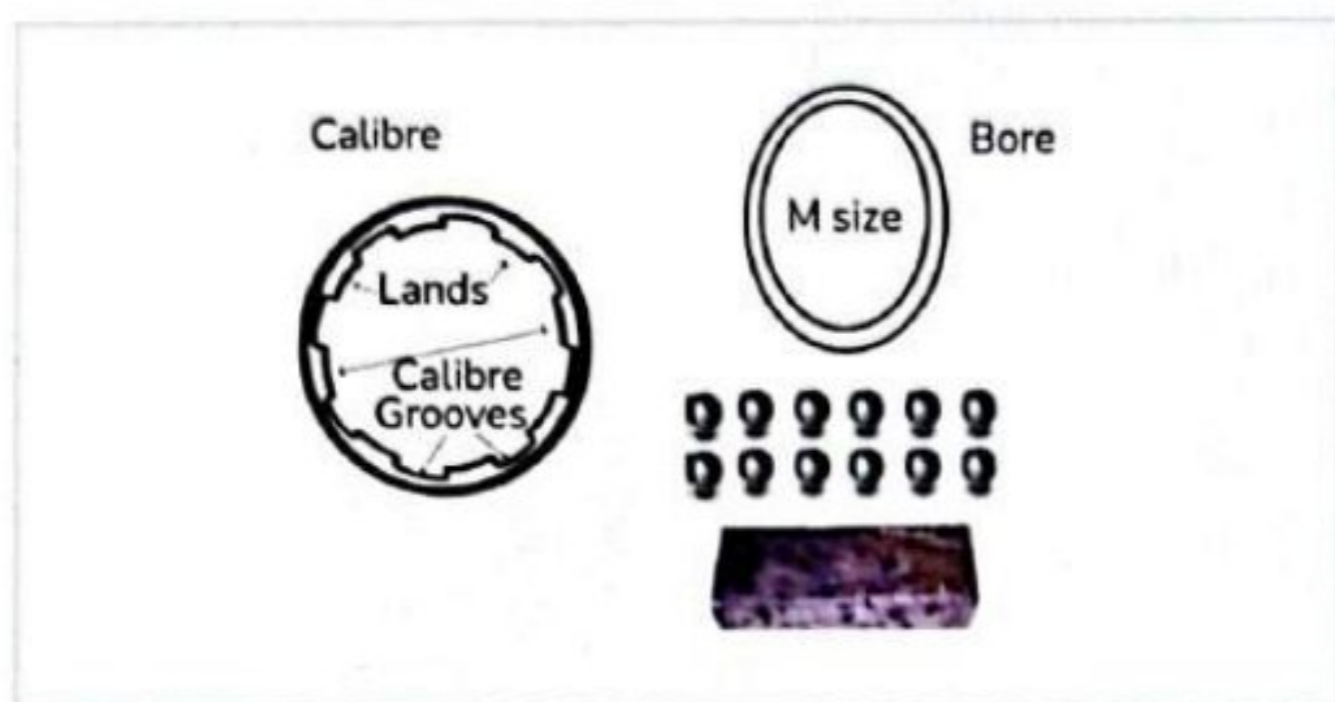


Rifled arm	Smooth bore firearm
<ul style="list-style-type: none"> • Condition of barrel: There is elevation and depression present. Elevations are known as lands, and depressions are known as grooves. 	<ul style="list-style-type: none"> • Condition of barrel: Inside surface is smooth in smooth bore firearm.
<ul style="list-style-type: none"> • Caliber: Distance between two opposite lands. 	<ul style="list-style-type: none"> • Caliber: Bore
<ul style="list-style-type: none"> • The projectile in the cartridge: Bullets 	<ul style="list-style-type: none"> • The projectile in the cartridge: Pellets/ lead shot
<ul style="list-style-type: none"> • Range: High 	<ul style="list-style-type: none"> • Range: Low

Advantages of Rifling in Rifled firearms:



- It has spin and rotation of the bullets.
- Increases accuracy and range (kinetic energy is more therefore range is more).
- It checks wobbling effect.
- It causes gyroscopic stability.
- Enhances wounding power.
- **Caliber or Gauge:** it is used for rifled weapons.
- **Bore or Gauge:** it is used for smooth bore weapons.
- The number of balls/pellets of equal size/weight are made up of **1 pound lead(454gm)**
- 12 bore = 12 balls
- Bore decides the size of the pellets



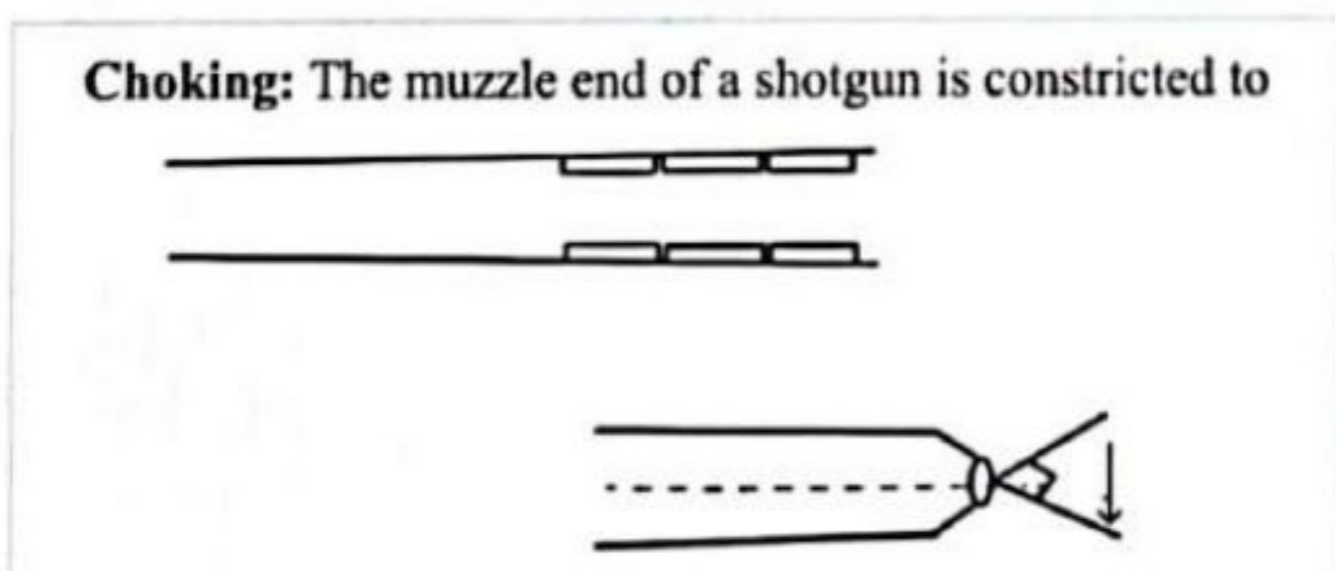
Helixometer: It is an instrument to examine the inner surface of a barrel.

How to increase the range of Shot-Gun

Different ranges of Firearm:

- Shotgun: 50 to 60 yards
- Revolver: 200 yards
- Pistol: 400 yards
- Military Rifle: 1000 to 3000 yards
- Airgun: 40 yards. The mechanism is air compression. Absence of tattooing, blackening, and singeing.

Paradox gun: It is a mixed gun. It has features of both rifle and shotgun. It is a shotgun in which a part of the barrel towards the muzzle is rifled.

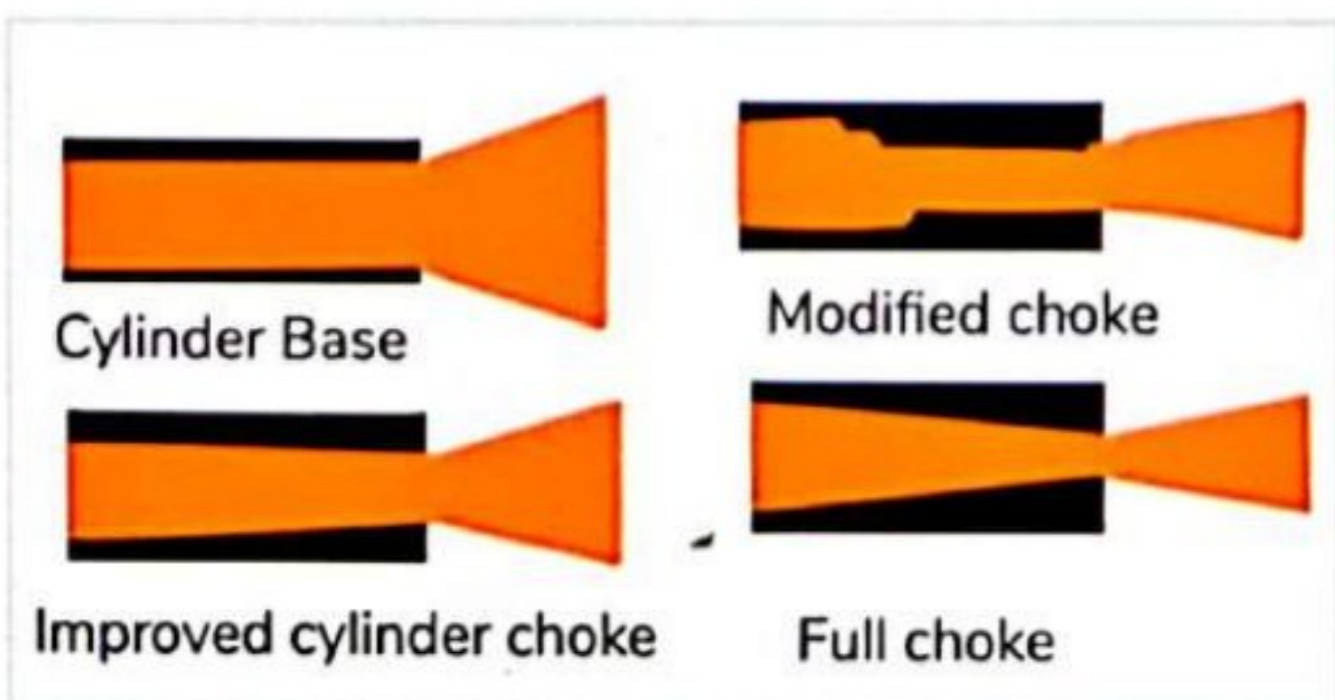


Choking: The muzzle end of a shotgun is constricted to

- Lessen the rate of speed of the shot.
- Increase the velocity of pellets.

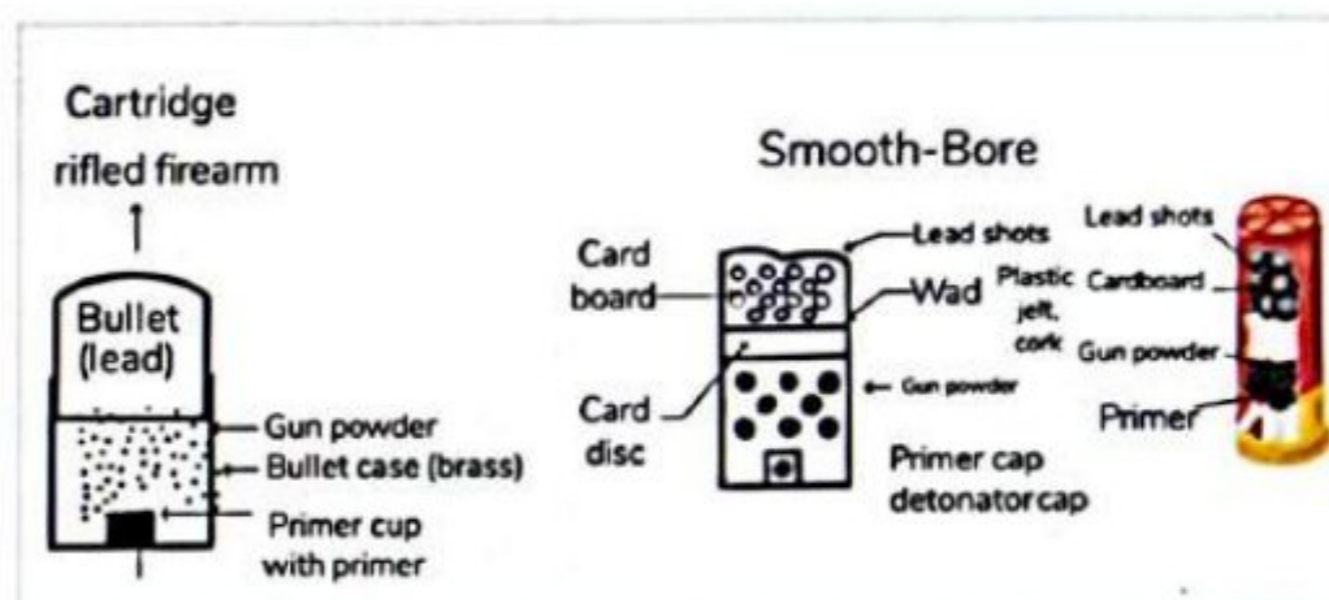
Different types of choking:

- Unchoked or cylindrical base: its range is 25 yards.
- Improved cylindrical choke: its range is 30 yards.
- Modified cylindrical choke: its range is 35 yards.
- Full choke: its range is 40 yards.



Cartridge: Loaded within the firearm

- Primer: which ignites
- Propellant: Gunpowder
- Projectile: In rifle, it is bullets, and in the smooth bore, it is pellets.



The Rifle cartridge:

- On the base, we have a primer cup.
- In a rifled firearm, we have a bullet case composed of Brass (copper + Zinc)
- A bullet made of lead.

Cartridge of Smooth Bore Firearm:

- Primer cap/ detonator cap/ percussion cap
- Gun powder
- Cardboard disc as known as Wad.
- Lead shots.

Wad Function:

- It separates projectiles from propellants.
- It seals air.
- It acts like a piston and lubricant.

Lead Shot: it is pellet/ lead balls.

- Soft: composed of lead
- Hard: composed of Lead and Antimony
- Steel: composed of steel

Size: It varies from Dust shot, Birdshot, and Buckshot.

Primer Composition:

- B- Barium Nitrate
- L- Lead peroxide
- A- Antimony
- S- Styphnate/ Antimony Sulphide
- T- Tetrazine

The function of Primer:

- 1st it burns then detonates (explodes) and then ignites the gunpowder.

Gun Powder: it is of 3 types.

1. Black (POCSO)
 - PO: Potassium Nitrate (75%)

- C: Charcoal (15%)
- SO: Sulphur (10%)
- 1gm produce 3000-4000 cc of gas.
- Produce more smoke.
- Have less power.

2. Smokeless

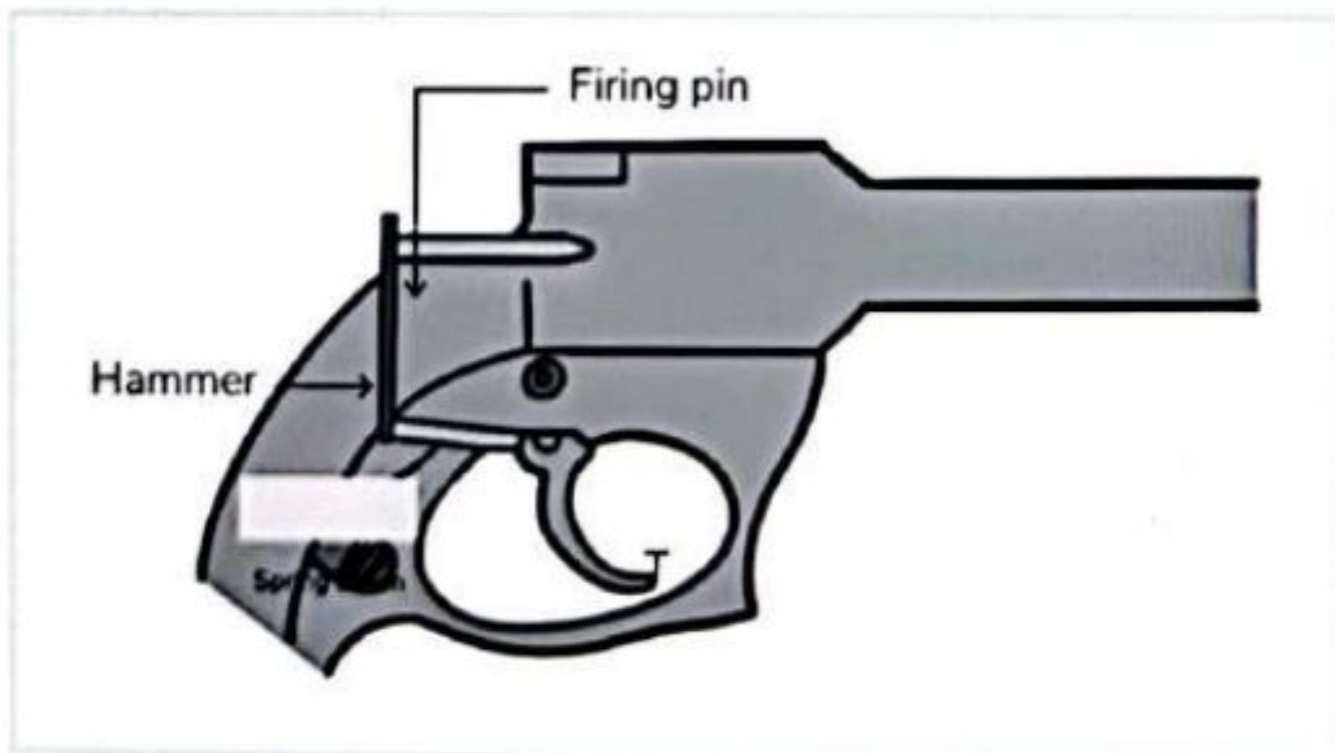
- Single base: it contains Nitrocellulose.
- Double base: it contains Nitrocellulose and Nitro-glycerine
- Triple base: it contains Nitrocellulose and Nitro-glycerine, Nitroguanidine
- 1 gm produces 12000-13000 cc of gas.
- Produce less smoke.
- Have high power.

3. Semi Smokeless Gunpowder contains 80% Black and 20% Smokeless gunpowder.

- Designated as FG, FFG, FFFG, etc. in gunpowder are known as
- FG: fineness of gunpowder. When the number of F increases, there will be an increase in the fineness of gunpowder and an increase in power.

Gunshot Residue Test (GSR): Composed of primer and lead.

- H-Harrison and Gillroy test. It can detect Antimony, Barium, and Lead.
- A- Atomic absorption Spectrometry. It can detect Antimony, Barium, Copper, and Lead
- N- Neutron activation analysis.
- D- Dermal nitrate test, also known as Paraffin test.
- S- Scanning electron microscopy energy dispersive X-ray analysis (SEM-EDXA). It is the most specific test.



The sequence in Firing:

- Pull the trigger. Once you pull the trigger, the hammer will rise. It will move upwards and release, hitting the firing pin, and then it will move forward. So, the primer burns. Then the primer burns, and flames produce gunpowder. When gunpowder ignites, gas or smoke in a small compartment is produced, and the projectile can out.

Bullets:

- Damage depends on the velocity.
- Large round bullets have greater damage.
- Should be picked by hand from the crime scene.

Types of bullets:

00:41:59

- Souvenir bullet: also known as sleeping bullet. It is a retained bullet in the body or skin. Surrounding the bullet there will be fibrosis; it is composed of lead. So, it will cause lead poisoning, which is known as Plumbism.
- Frangible: It divides into multiple components. Composed of Iron and copper.
- Tumbling: Rotates end-to-end.
- Duplex: Two bullets in a cartridge.
- Tracer: Can be traced in your pathway. Because the base is composed of illuminating subjects.
- Incendiary: Contains phosphorus. It catches fire.
- Yawning: Slow and irregular bullet.
- Tandem: It is when the second bullet is pushing the first bullet. In this, two bullets are coming out, it is called tandem also known as piggyback bullets.
- Plastic or Baton bullet: It is composed of ^{prince kumar}polyvinyl chloride ₉₉₂₈₆₀₉₇₃₃ and used in riot control.
- Poison bullet: Curare, resin. Any type of poison in a bullet is known as a poison bullet.

Ricochet bullet: If a bullet is deflected from any object, it goes into your body.

- Critical Ricochet angle is 30 degrees.
- Spin and rotation lost, so no abrasion collar.
- Burning, blackening, and tattooing all are absent.
- Round nose tip bullet - Round Tip
- Sharp nose bullet- Sharp pointed Tip
- Fully jacketed bullet- Copper jacket
- Semi-jacketed bullet- Nose is not jacketed, expanded inside tissues.

It can be of two types:

- Dum-Dum Bullets
- Hollow Pointed Bullets
- This causes more external damage due to expansion.

Kennedy Phenomenon:

- Surgical alteration of gunshot wounds. If it dies during the post-mortem, it is difficult to identify the entry, exit wounds, and range difficulty.

Rayalaseema Phenomenon:

- Bullets are implanted in stab wounds to mislead the investigation.

Discharge from Gun- Effects:

- **Flame:** Causes burning of hair, charring, singeing
- **Smoke:** Smoke is deposited surrounding the skin. This phenomenon is known as blackening and smudging.
- **Unburned Gun Powder:** That is impregnated in the skin and known as tattooing, peppering, and stippling.
- **Projectiles from Shotgun:** Lead shot (wad), projectile from rifle (bullet)

MCQs

Q. Who is the father of ballistics.?

Ans. Calvin Goddard.

Q. Which instrument is used to examine the inner surface of barrel.?

Ans. Helixometer.

Q. Among the following, what are the advantages of rifling in a rifle?

- a) Increase the accuracy and speed
- b) It Causes gyroscopic stability
- c) Enhance the wound power.
- d) All of the above

Ans. d

Q. In which gun the barrel towards the muzzle end is rifled.?

Ans. Paradox gun.

Q. What acts like Piston and Lubricant?

Ans. Wad

Q. Most specific test of Gunshot Residue Test.?

Ans. Scanning electron microscope.



PREVIOUS YEAR QUESTIONS



Q. Assertion: Range of shot can be determined by the spread of pellets.

Reason: Shotgun cartridge contains pellets?

(AIIMS May 2019)

- A. Both assertion and reason are correct and reason is correct explanation of assertion.
- B. Both assertion and reason are correct but reason is not a correct explanation of assertion.
- C. Reason correct assertion wrong
- D. Both assertion and reason are wrong

Q. Bullet wipe term is used for? (AIIMS May 2019)

- A. Gutter fracture of skull
- B. Blackening
- C. Tattooing
- D. Dirt from barrel

Q. A middle aged lady was found in a robbed room lying in a pool 0-6 blood. On forensic examination there was an entry wound of size around 2 x 2 cm on the left temporal region with tattooing and blackening right temporal region. On further examination two bullet fragments were found inside the brain parenchyma. Which of following could be used to determine the distance from which the weapon was fired?

(AIIMS Nov 2017)

- A. Hair
- B. Clothes
- C. Bullet fragments
- D. Blood

Q. Bullet fingerprinting is?

(AIIMS Nov 2018)

- A. Human fingerprints on bullet
- B. Primary marking
- C. Secondary marking
- D. Distorted bullet

Q. The poisoning caused by bullet retained inside the body is?

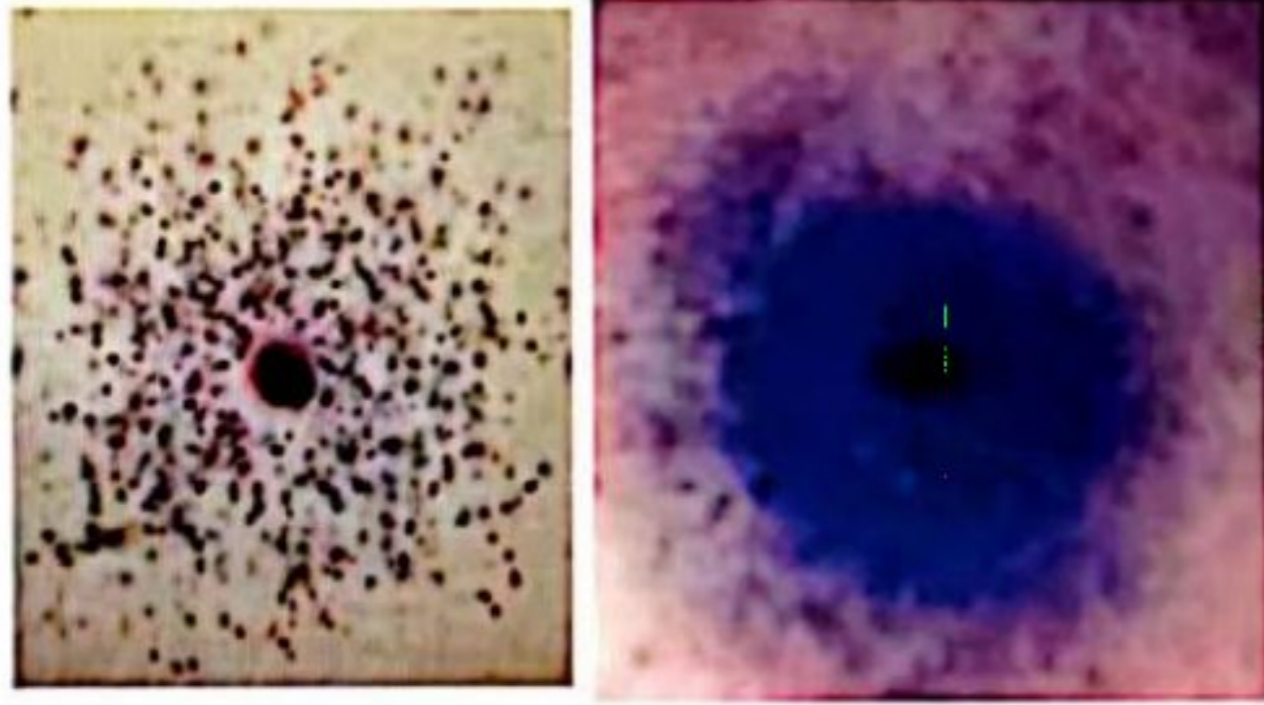
(FMGE Dec 2019)

- A. Iron
- B. Phosphorus
- C. Nitro cellulose
- D. Lead



Discharge from Gun Effects

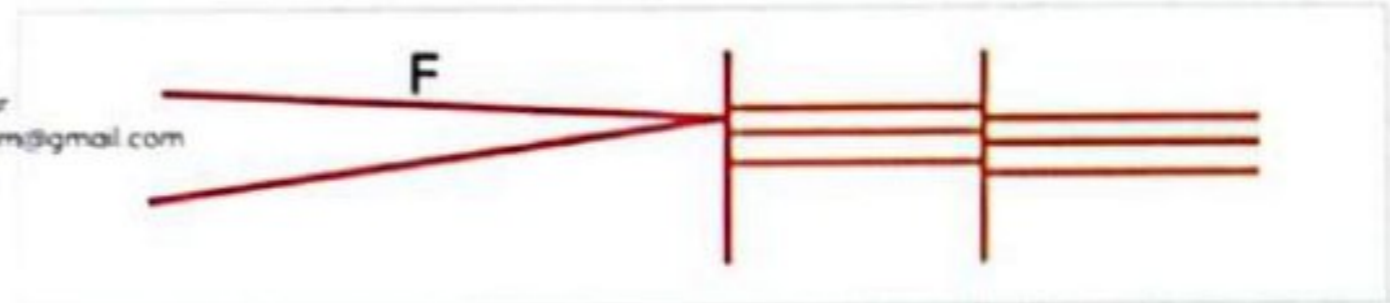
- Flame - Causes burns.
- Smoke - Causes blackening.
- Unburned gunpowder - Causes Tattooing
- Projectiles



Range of Rifle and Shotgun

00:06:19

Range	Rifle	Shotgun
Flame (Burning)	7 cm	15 cm
Smoke (BL)	30 cm	45 cm
Gunpowder (TAT)	60-90 cm	60-90 cm



Burning vs Tattooing

- Cotton cloth is immersed in water and wiped at the site.
- **Blackening** - Black color wiped out.
- **Tattooing** - **Not wiped out.**

Grease Collar vs Abrasion Collar

- Present an **entry wound**.
- Usually seen in rifles.

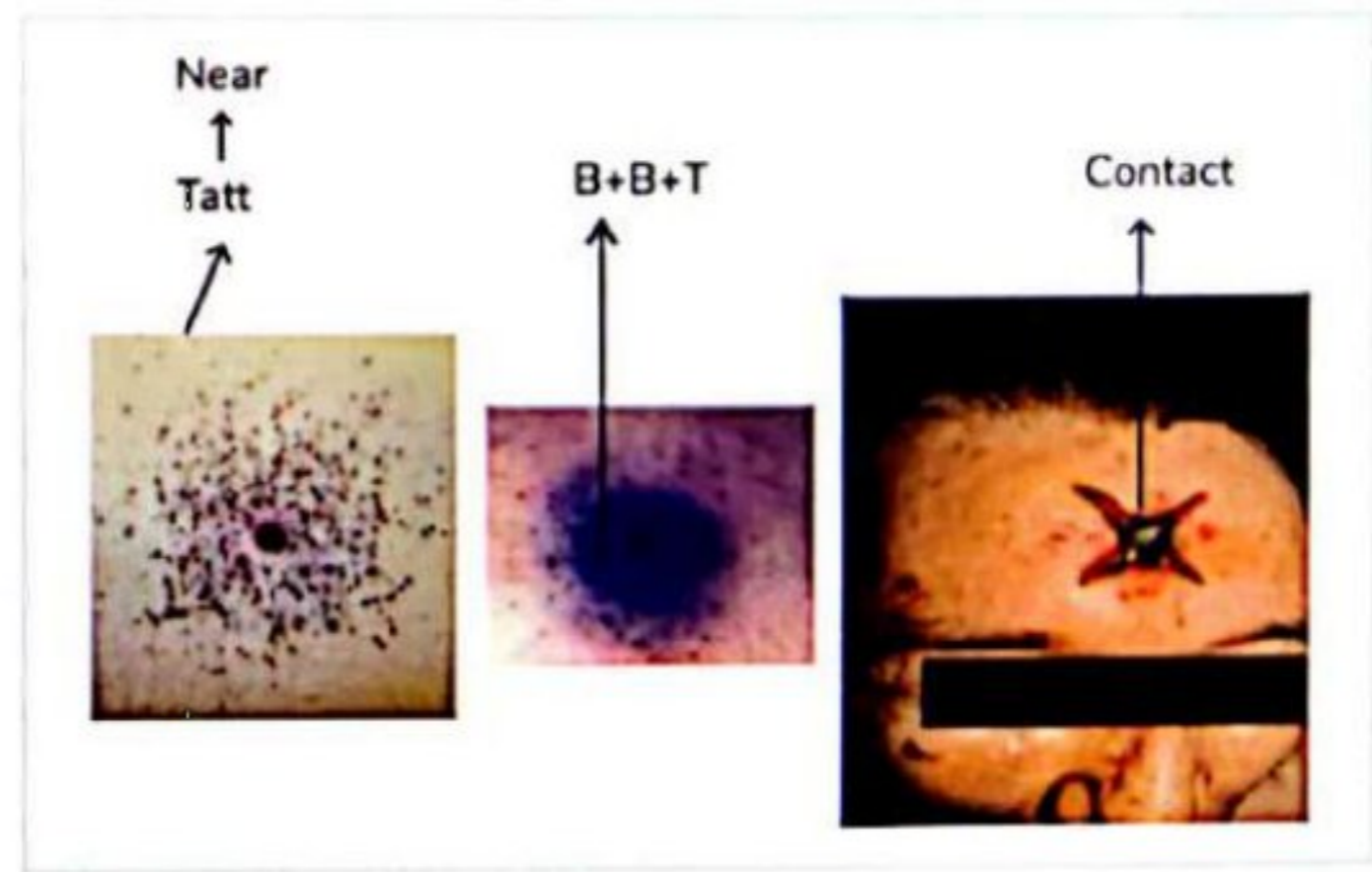
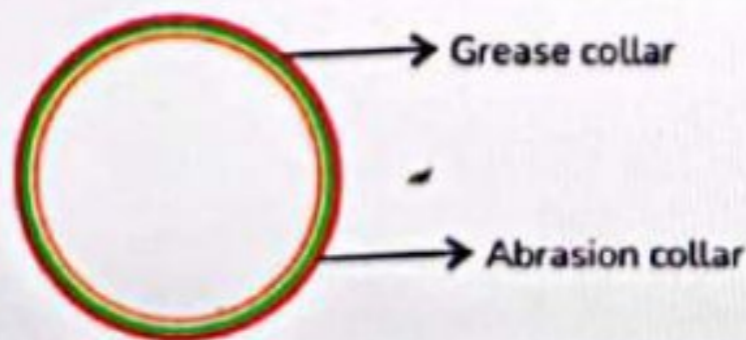
Contact Shot - Rifled Weapon

Refer Table 17.1

Rifled Firearm

	Contact	Close shot	Near	Distant
Muzzled impression	+	-	-	-
Shape of wound	Stellate	Circular	Circular	Circular
Burning/Blackening/Tattooing	All present, that too inside the track	All present	Only Tattooing	-
Grease or Abrasion collar	+	+	+	+

Grease Collar	Abrasion Collar
Produced by the grease of bullet	Produced by spin or rotation of the bullet
More specific	Comparatively less specific
Inner side	Outer side
	Gives an idea about angulation. <ul style="list-style-type: none"> • Perpendicular entry - Round Collar • Oblique entry - oval collar
	<ul style="list-style-type: none"> • Absent in palm and soles, and if the bullet isn't spinning. • If the person is attached to a surface, can be found in exit wounds as well - that is called Shored exit wound



Entry vs Exit Wound

Character	Entry Wound	Exit Wound
Size	Small	Large (except in contact)
Margins	Inverted V	Everted ^
Abrasion and Grease Collar	+	-
Burning + Blackening + Tattooing	+	-
Bleeding	Less	More
Cherry red color (due to CO+Hb)	+ (maybe)	-
Fat and soft tissue expulsion	-	+

Metal Fouling

- Tiny lesions around the entry wound formed by
 - Surface of missile (bullet)
 - Interior of barrel

Bullet Fingerprint

- **Primary marking**
 - Rifling of barrel
 - Gives model of weapon or gun.
 - Class characteristic
 - Land/ groove
- **Secondary marking**
 - Irregularity inside the barrel
 - Cleaning
 - Manufacturing defects
 - Wear and tear inside
 - Individual characteristic
 - If striations are present - A comparison microscope is used



- If same striations, same brand bullets

Q. Which is a gross bullet fingerprint marking

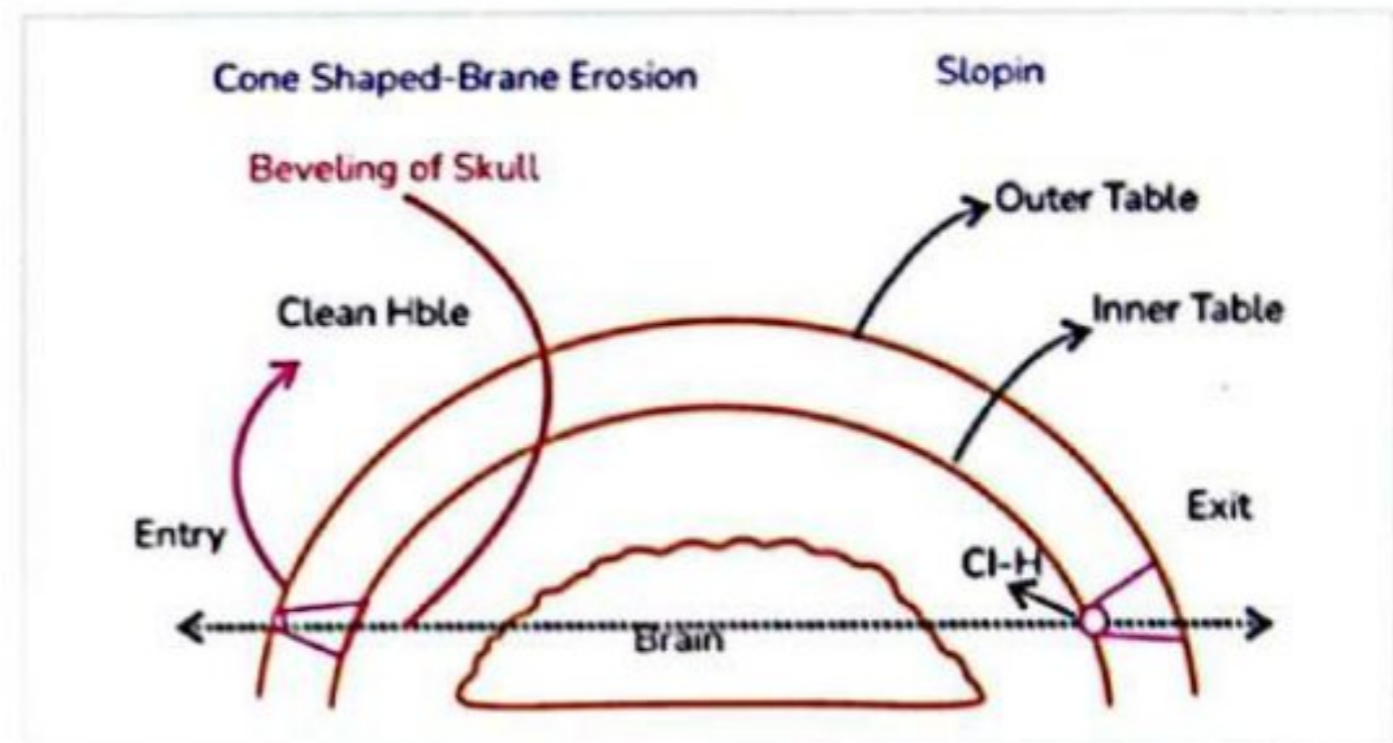
Ans. Primary marking

Q. Which is a microscopic bullet fingerprint marking

Ans. Secondary marking

Beveling of Skull

- Cone-shaped bone erosion



Beveling of Skull phenomenon

- Going to any table - Clean wound
- Coming out from any table - Cone-shaped erosion

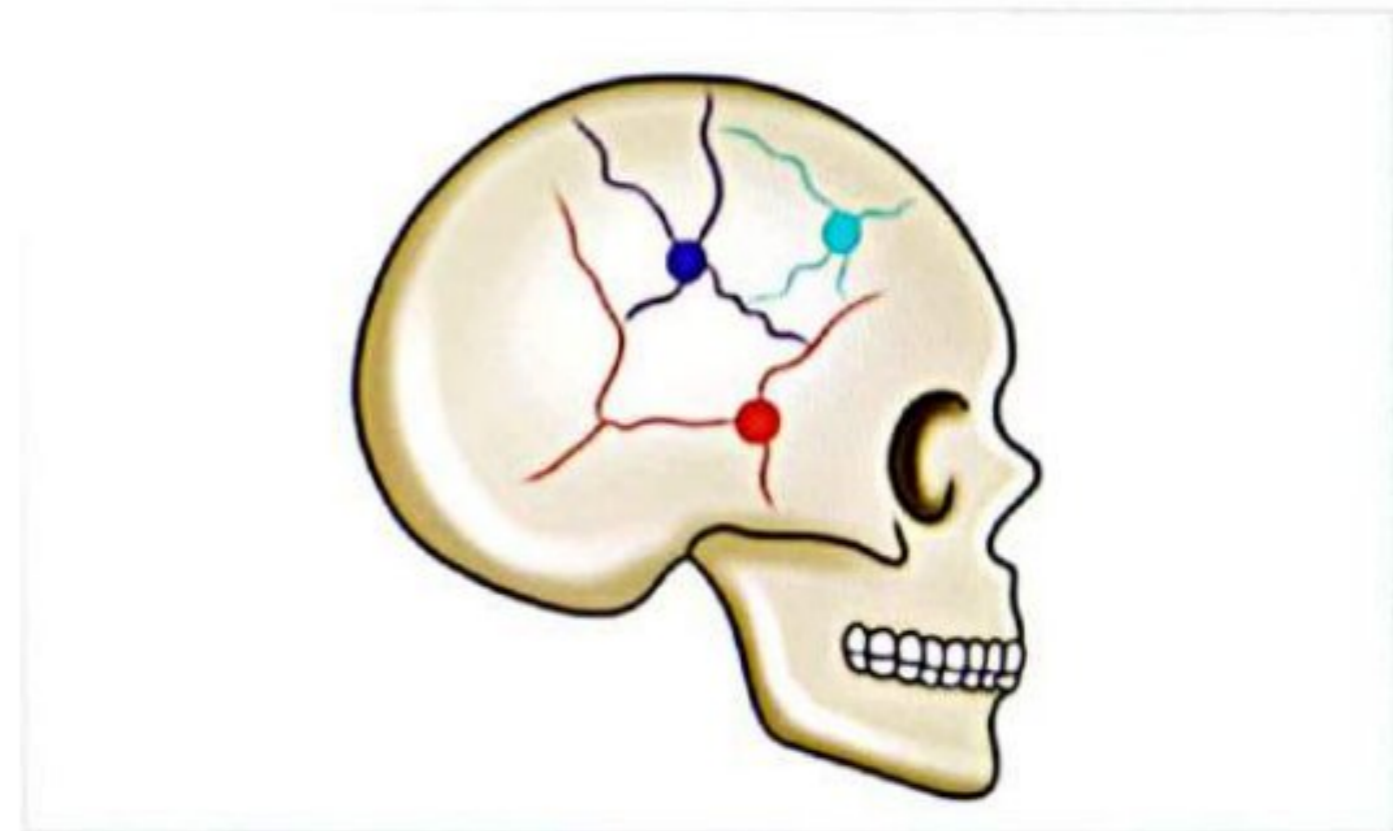
One Liners

- Beveling is always seen at the exit point of the table.
- In entry wound Beveling is towards the inner table.
- In exit wound Beveling is towards the outer table.

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Puppis' Rule

- Used for sequencing of bullets.



- 1st fracture line - Normal
- 2nd fracture line - Never crosses 1st line.
- 3rd fracture line - Never crosses 1st and 2nd lines.

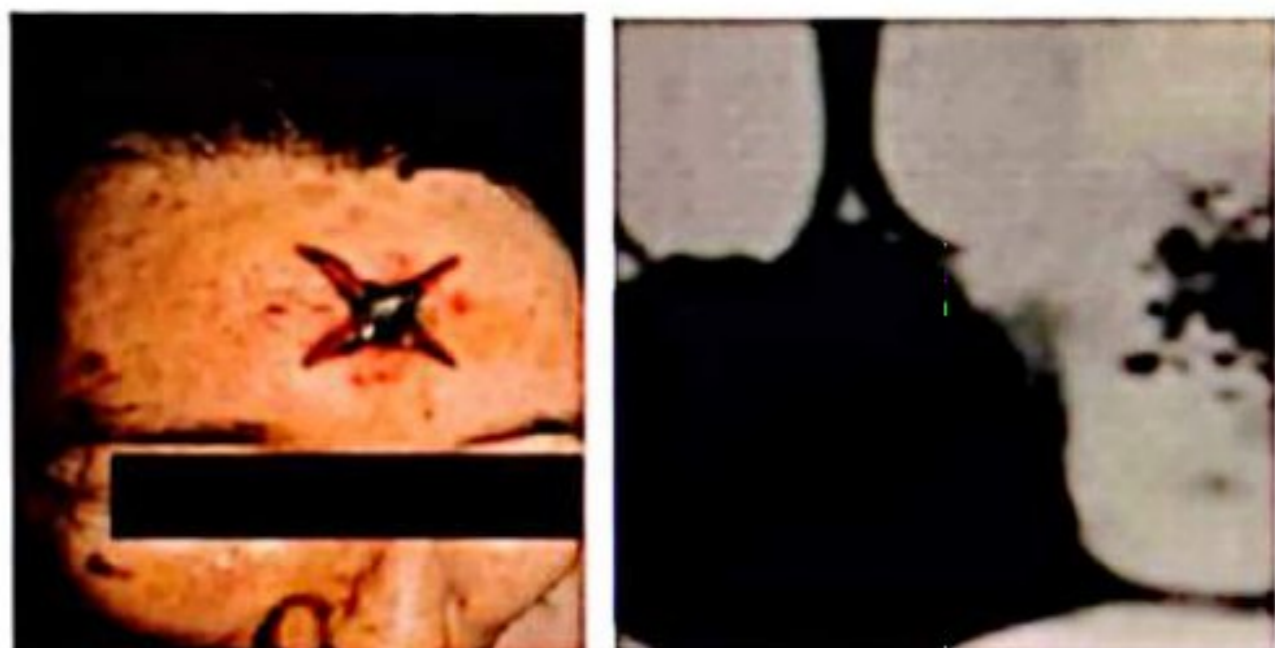
Kronlein Shot

- Range - Close
- Skull - Bruised
- Brain - Evisceration

Shot-Gun

- Lead shot/ pellets
- Gunpowder travel: 60 to 90 cm
- Blackening + Burning + Tattooing: Till 1 m
- Dispersion of pellets start: >2 m (intermediate)
- Complete dispersion: >4 m
- Wad lesion: 2m

Refer Table 17.2



Billiard Ball Effect vs Balling/Welding

- Both are atypical patterns of Shotgun injury

Billiard Ball Effect	Balling/Welding
<ul style="list-style-type: none"> • Dispersion of short pellets • Lead shots will disperse in high range when they strike any surface. • Other name: Billiard Ball Ricochet Effect • Dispersion is very high • Range is short 	<ul style="list-style-type: none"> • Sticking of Lead shots • Distant range shots will stick together, maybe due to melting down of lubricant or fragments. • Large entry wound + Some dispersion • Dispersion is less. • Range is long. • Will give the appearance of a satellite (but not intermediate)

Range	5 metres	10 metres	15 metres	20 metres	
Cylinder	20	50	60	75	dispersion in cm
Half choke	13	30	40	50	
Full choke	8	25	35	45	

Table of Different Ranges of Different Shotguns

- Mnemonic: CHF

Blast Injuries (Bomb Blast)

00:39:22

Types

- Air blast (midair)
- Underwater blast (liquid or water)
- Solid blast (on solid surface) - Ex: Mine blast
- Products of the Blast
 - Airwave/ blast wave/ shock wave-Air compression is seen.
 - Flying missiles/ projectiles/ objects-Flying pieces, needles, and other sharp objects may hit people.
 - Lifted and thrown around - Person may hit ground, tree, etc.
 - Miscellaneous - Building collapse, burns, and fumes may give injury.

Primary Blast Injuries (Airwave or blast wave)

- Barotrauma - Due to blast wave
- Hollow organs
 - Ear
 - Most common tympanic membrane is affected (bleeding, perforation)
 - Ossicles
 - Lungs
 - Most fatal injury
 - Alveoli, capillaries, basement membrane all are damaged (blast lung)
 - GIT
 - Vomiting
 - Malena
 - Perforation

Secondary Blast Injuries (Flying objects)

- Marshall's triad is produced.
 - Punctate abrasion
 - Punctate contusion
 - Punctate laceration

Tertiary Blast Injuries (Throwaway due to air/wind)

- May hit other objects like ground, or hard surfaces as such.
- Leads to skeletal fractures or injuries.

Quaternary Blast Injuries

- Building collapse - Traumatic Asphyxia
- Burn/ Fire/ Flame injuries.

Quinary Blast Injuries

- Environmental contaminants
- Chemicals (Cl, Savin)
- Radiations (nuclear bomb)
- Virus and bacteria (bio wars)

Bomb

- Having explosive materials.

Types

- **Incendiary bomb**
 - Contains phosphorus and magnesium.
 - Catches fire.
- **Molotov Cocktail**
 - **Other name: Petrol bomb**
 - **Half bottle is filled with petrol.**
 - Rag is present for ignition.



Important Information

Most Common Organ Injured

- **Air blast** - Tympanic membrane > Lungs
- **Underwater blast**
 - Nothing mentioned - GIT.
 - Head below water - Tympanic membrane
 - Head above water - GIT



Table 17.1


Close Contact	Loose Contact	Bone Contact
<ul style="list-style-type: none"> • Circular entry wound • Muzzle impression • Blackening/ Burning/ Tattooing inside • Blood and tissue may enter the barrel (Back spatter) 	<ul style="list-style-type: none"> • Smoke layer is formed (Corona) 	<ul style="list-style-type: none"> • Energy + expanding gasses, cause skin rupture (blowback phenomenon) • Stellate/ cruciate shape wound.
		
		Stellate/ cruciate shape wound

Table 17.2

Characteristic	Contact Shot	Close Range (1m) O	Near Range (1-2m) R	Intermediate-Range (2-4m) S	Distant Range (>4m)
Entry wound appearance	Stellate/ cruciate	Circular (O)	Rat-hole (nibbled margin)	Satellite (large multiple palettes)	Individual palettes
Muzzle impression	+	-	-	-	-
Blackening/ Burning/ Tattooing	Inside the track	All	Only tattooing	-	-

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- It is the study of poisons, their type, actions, signs and symptoms, and the management and treatment, and antidote of poison.
- Toxinology
 - Study of living toxin
 - Eg plant toxins, virus toxins, and bacterial toxins.
- Founder of modern toxicology - Orfila
 - Spanish toxicologist
- Father of modern toxicology - Paracelsus



Paracelsus

Orfila

Ideal Homicidal Poison

00:01:34

- Ideal homicidal poison is **Thallium**.
- Most commonly used homicidal poison.
 - Arsenic
 - Aconite
- Quality
 - Cheap and easily available.
 - Toxic enough to kill a person.
 - Colorless, odorless, and tasteless.
 - Causes a slow and gradual death.
 - Signs and symptoms should resemble natural diseases.
 - No antidote, no Post-mortem changes.
 - Rapidly destroyed in the body
 - Should not be detected by a doctor or Post-mortem.

Ideal Suicidal Poison

- Ideal Suicidal poison is cyanide.
 - Not easily available
- Most commonly used Suicidal poison.
 - Organophosphate
 - Opioids
 - Sometimes, barbiturates
- Quality
 - Cheap and easily available.
 - Toxic enough to kill a person.
 - Tasteless
 - Capable of producing painless death.

Duty of doctor during poisoning

00:04:28

- Document (medico-legal certificate) is made.
 - MLC
 - Post-mortem report
- Preservation of Sample and Evidence.
 - Sample from gastric lavage.
 - Blood sample
 - Vomit sample
- Police Information
 - 39 CrPC-Any poisoning case doctor should inform the police.
 - 176 IPC - Non-compliance – punishable.
 - 177 IPC - False information to police – punishable.
 - 274 IPC - Drug - adulteration of drug – punishable.
 - 284 IPC - Negligence regarding poison - leading to death or damage.
 - 328 IPC-Hurt by poison with criminal intention - punishable.

Information to the police

- Related to 39 CRPC.
- Homicide
 - Must inform.
- Suspicious (suspicion of poisoning)
 - Must inform.
- Unknown substance consumed.
 - Must inform.
- Attempt of suicide (the person confesses that they committed suicide).
 - Not mandatory to inform.
- Any suspicion of suicide
 - Must inform.
- Patient death due to complications or during treatment
 - Must inform.
- Dead on arrival
 - Must inform.
- Dying declaration arrangement.
 - Patient with a sound mind wants to give a dying declaration.
 - It can be arranged by a doctor.

NDPS Act

00:09:59

- Narcotic drugs and Psychotropic substances used.
- **Last minute point copy - Mnemonic**
- L - LSD
- M - MDMA (ecstasy)
- P - Phencyclidine
- Copy

- Cocaine
- Cannabis
- Opioid
- Poppy
- The NDPS act was implemented in 1985 and there are some illegal issues associated with it.
- If the Possession of the drug is in a small quantity.
 - Punishment 6m or 10k fine or both.
- If possession for commercial use - 10-20y + 1-2 lakh fine.
- Consumption
 - Rigorous 6m+20k
- Cultivation
 - 10y Rigorous imprisonment + 1 Lakh fine.

Old laws:

- Opium act
 - Opium act I - 1857
 - Opium act II - 1878
- Dangerous drug act
 - 1930

Drug and Cosmetic Rule

- Implemented in 1945
- Drug and cosmetic act - 1940
- Schedule C (trick - before c come B)
 - Biological drug
 - Formed by biological product.
- Schedule G (trick - with G comes H)
 - All hormones
- Schedule F (trick - FB - Facebook)
 - Blood product
 - Sera
 - Vaccine
- Schedule H (trick - HP laptop)
 - Prescribed
 - The drug has to be prescribed by RMP (registered medical practitioner)
- Schedule J (trick - faculty name JhamAD - AD)
 - Drugs not to be advertised.
 - AIDS
 - Blindness
 - Deafness
 - Diabetes Mellitus
- Schedule X (trick - causes spoiling of life - X)
 - Drug abuse
- Schedule E (trick - you say "EEE" when taking poison)
 - Poison

Toxicological Analysis

- When someone dies from a poisoning case, toxicology analysis is done.
- Also known as chemical analysis.

- Note – The question comes on the preservative used.
- Viscera is used for a toxicology report.
 - Stomach and its content
 - Small intestine (30 cm of its proximal part and its content).
 - Liver around 500 gm with the gallbladder.
 - One-half of each kidney.
 - Half of the spleen.
- Apart from viscera we take.
 - 100 ml of blood from Peripheral veins
 - 100 ml of urine
- Preservative used.
 - For blood
 - Sodium fluoride
 - It inhibits glycolysis (enolase enzyme and inhibits the growth of bacteria).
 - Potassium oxalate - it is an anticoagulant.
 - For urine
 - Toluene (trick - same sound as urine when pronounced)
 - Thymol
 - For viscera
- A question can come -
 - The most commonly used preservative for viscera.
 - Sodium chloride (common salt)-its saturated solution.
 - It is cheap.
 - Ideal preservative
 - Rectified spirit (90 percent ethanol)
- Contraindication of rectified spirit (trick - PAPP don't use ethanol)
 - P - Phenol
 - A - alcohol
 - P - Phosphorus
 - P - Para aldehyde
 - A - Acetic Acid

Special Preservation

00:22:06

- Muscle (skeletal muscle of buttock): used when the body is putrefied.
- Body fat: used in Endrin, DDT.
- Bone, hairs, and nails: used in heavy metals.
- Lungs: used for either gaseous poison or volatile poison.
- Bile and gallbladder preservation: Used for
 - G - Glutathione
 - B - Barbiturate
 - Opioids
 - Nicotine
 - Alcohol
- Spinal cord: used for strychnine.
- Brain: used for cerebral poison or organophosphate.
- CSF: used for alcohol.
- Heart: used for aconite.

Special smell

- Fruity/sweet smell: from Ethanol, chloroform.
- Acrid smell: from paraldehyde, chloral hydrate.
- Rotten eggs smell/sewer gas smell: H₂S.
- Rotten fish smell: Aniline.
- Kerosene odour smell: organophosphate = Aromax
- Fishy or musty smell: Aluminum, zinc phosphide.
- Bitter almonds smell CN⁻(cyanide)
- Burnt rope smell: Cannabis.
- Shoe polish smell: Nike = Nitrobenzene
- Garlic
 - Arsenic:
 - Phosphorus (pizza) = Thallium
 - Some organophosphate - parathion = Tellurium

Colour of postmortem staining

- Cherry red: Carbon monoxide poisoning = CO
- Bright red: Brick red = CN⁻
- Dark brown
 - Mnemonic - PAN
 - P- Phosphate
 - A- Aniline (blue colour)
 - - Nitrite
- Black: Opium.
- Bluish green: H₂S.
- Bronze: Clostridium perfringens.
- Purple: Methanol
- Hypothermia: Bright pink colour

Poisons causing PCT necrosis.

- P- Phenol (another product is Lysol)
- C- Carbon
- T- Tetrachloride
- PCT is caused by mercury.

Gastric lavage

Gastric lavage Tube

- Stomach wash
- Tubes used.
 - Ryles tube- Child.
 - Ewald/Boas tube- Adult.
- Ideal tube is Lavacutor tube.
- Ideal time is within - 3 hours.
- Done by Ewald/Boas tube (total length is 150cm and marking at a point 50 cm from tip).



Gastric lavage fluid

- Warm water (35°C)/normal saline: Most common.
- Potassium permanganate (1:5000)
 - Even used in higher concentrations in opium poisoning.
 - Some poison even if they are taken from the parenteral route, we can go for gastric lavage.
 - Morphine, Cocaine, Amphetamine, Barbiturates.
- Sodium bicarbonate (5%)
- Tannic acid (4%)
- Sodium or potassium iodide (1%)
- Calcium lactate. (1-3%)

For heavy metals

- We give specific chemical antidotes in gastric lavage.
- Gastric lavage fluid is freshly prepared.
 1. Ferric oxide - Arsenic.
 2. Sodium formaldehyde sulphoxylate - Mercury
 3. Potassium ferrocyanide - Copper

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Contraindication of gastric lavage

- Corrosive
 - Absolute contraindications
 - Corrosive causes blackening of mucosa and thinning of the mucosa.
 - So, if we are putting a tube in the mucosa there are chances of Perforation.
- Relative contraindication
 - C- Convulsant, comatose patient.
 - V- Volatile poison = kerosene = aspiration pneumonia.
 - Esophageal varices.
 - P- advanced Pregnancy.
 - H- heart disease hypothermia and hemorrhagic diathesis.
- Corrosive where we can go for gastric lavage is Carbolic acid.
 - Because in carbolic acid mucosa is not thin.
 - It is thick and leathery mucosa.

Complications of gastric lavage

- Aspiration pneumonia.
- Gastrointestinal perforation.
- Laryngeal spasms.
- Vagal inhibitions.

Universal antidote in gastric lavage

- Trick - Universally ATM is present (present everywhere)
- A- Activated charcoal
- T- tannic acid
- M- Magnesium oxide
- The ratio of A:T:M = 2:1:1

Activated charcoal.

- Black color
- Function of Activated charcoal
 - It adsorbs the poison on the surface.

- It is an example of a physical or mechanical antidote.
- Dose
 - 1 g per 1 kg of body weight

Tannic acid

- Causes precipitation of alkaloids.

Magnesium oxide

- Causes oxidation of Alkaloid
- Causes neutralization of acid

Coma cocktail

- If by poisoning someone goes into a coma it is administered
- Trick - DNB 1 (when appearing for DNB exam the first time you will go in comma)
- D - Dextrose
- N - Naloxone
- Vitamin B1 - Thiamine
- Naloxone helps with opioid-induced coma.
- Thiamine is used alcohol-induced coma.
- Dextrose helps in a coma due to Hypoglycemia.
- All this is given in combination.

Emetics

IPECAC

- Vomiting agent
 - It is a syrup given in 30 ml.
 - It is contraindicated in.
 - Corrosive
 - Convulsant
 - Coma
 - Hydrocarbon

Antagonism

00:45:22

- Types of antagonism or antidote
 - Physical antidote
 - Acts physically.
 - Mechanism
 - Adsorption
 - Eg charcoal
 - Coating
 - Eg milk or starch (Dimulsant)
 - Dissolving in it
 - Chemical antidote
 - It neutralizes chemically.
 - Eg
 - Acid is used for alkali poisoning.
 - Chelating agent - eg EDTA, penicillamine
 - Copper sulfate-neutralizes phosphorus poisoning.
 - Physiological antidote
 - Opposite function at different receptors or mechanism
 - Eg-Amyl nitrite is a physiological antidote for cyanide.
 - Converts hemoglobin to methemoglobin.

- Pharmacological antidote
 - Opposite action on the same receptor (Pharmacological antagonist)
 - Eg-in organophosphate, atropine & oxime are given.

Antidotes in different poisoning

- Paracetamol- N-Acetyl cysteine.
- Methanol.
 - Ethanol- a better antidote
 - Fomepizole
- CO poisoning - Hyperbaric oxygen
- Benzodiazepine - Flumazenil.
- Opiates - Naloxone, Naltrexone, or Nalmefene.
- Organophosphorus
 - Atropine
 - Oxime
- Cyanide (PYQ)
 - Amyl nitrate
 - Sodium Nitrite
 - Sodium Thiosulphate
 - All these are called triple antidotes or Lilly's antidotes.
- Thallium
 - Prussian blue
- Methemoglobinemia
 - Methylene Blue

Chelating Agents- USED IN

- Form chemical complexes with heavy metals.

00:51:24
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British Anti Lewisite (BAL):

- Another name is Dimercaprol.
- It is a peanut oil suspension.
- It has two unsaturated sulfhydryl group which combine with the metals and prevents its union with SH of the respiratory chain.
- The complex is stable and easily excreted in the urine.
- BAL is administered in Deep intramuscular injection.
- Used in arsenic, lead, copper, mercury, thallium, and antimony poisoning.
- Contraindicated in Cadmium and Iron Poisoning, also in liver failure and G6PD deficient Individuals.

EDTA (Ethylenediaminetetraacetic acid)

- Contraindicated in mercury.
- Used in lead.

The trick to remember - LEAD.

In LEAD, we use EDTA first, then DMSA

DMSA- 2-3- Dimercaptosuccinic acid

- Can be given in many poisons.

Penicillamine

- It is a chelating agent for copper
- Contraindicated in arsenic.

Desferrioxamine

- Given in iron and heavy radioactive metals.

Contraindication for Hemodialysis

- Kerosene
- Benzodiazepines
- CuSo4, chloroquine
- Heroine
- Organophosphate
- Digitalis.

Alkaline Diuresis

- Done when the poison is acidic poison.
- P- Phenobarbitone
- S- Sulfonamide
- M- Methotrexate
- Chlorpropamide

Acidic diuresis

- Acidification of urine
- Amphetamine
- Morphine
- Strychnine
- Quinine
- Cocaine

Stomach Mucosa

- Slate color: mercury
- Blackening: Sulphuric acid
- Yellow: Nitric acid, (due to xanthoproteic reaction).
- Buffed white: Carbolic acid.
- Blue/green: Seen in CuSo4.
- Green: Ferrous sulphate.
- Blue: Amytal,
- Pink: Soneryl,
- Brown: Cresol,
- Gray, white/yellow: Phosphorous

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Insecticide (Agricultural Poison)

1. Organophosphorus Poisoning- Suicidal
2. Carbamate
3. OC (Organochlorine)
4. Pyrethroids

Organophosphorus Poisoning

Most common suicidal poison.

Types:

- Alkyl = Po₄ (Ex- Malathion, HETP, OMPP, TEPP).
- Aryl = Po₄ (Ex- Parathion (folidol), Diazinon (Tik-20)).

Mechanism of Action

- Irreversibly inhibits a carboxylic esterase enzyme (AChE= Acetylcholinesterase enzyme)
- Sites:
 - 1st site is NMJ.
 - Ganglions of nervous tissue
 - RBC
- AChE is phosphorylated and irreversibly inhibited.
- Overall effect will be cholinergic.
- It also inhibits the Pseudocholinesterase enzyme present in Plasma, Pancreas, Liver, Heart, Brain
 - Also known as Plasma or Butyryl Cholinesterase.

Signs and Symptoms

- Appears when Cholinesterase level drops to 30% of normal activity.
 - Mild= 20-50%
 - Moderate = 10-20%
 - Severe= < 10%
- RBC/ True Cholinesterase:
 - Most specific test.
- Plasma / Pseudocholinesterase:
 - Most common test because it Falls rapidly with Organophosphorus poisoning.
 - It is inexpensive.
 - Easy test
 - More sensitive test
- If giving 2 mg of Atropine in any case you are suspected of organophosphate Poisoning if the symptoms are relieved.
- Confirmatory test is the P-nitro phenol test.

Cholinergic Symptoms

- Muscarinic symptoms: overall secretion increased.
 - Diarrhea
 - Urination

- Miosis / Muscle weakness.
- Bronchorrhea, Bronchospasm.
- Bradycardia.
- Emesis.
- Lacrimation (red tear/ Chromodacryorrhea present because of Porphyrin secretion).
- Lethargic.
- Salivation

Nicotinic Symptoms

- Muscle weakness, Fasciculation, areflexia, muscle paralysis.
- Cause of death is RMP (respiratory muscle paralysis).
- CNS symptoms:
 - Headache
 - Tremor
 - Confusion
 - Slurred speech
 - Coma
 - Convulsion

Syndrome

00:12:50

- Acute: Increased Secretion
- Intermediate syndrome:

Seen in 1-4 days after acute poisoning, Because of prolonged cholinesterase inhibition and muscle necrosis. Proximal Limb Weakness occurs. It does not respond to oximes or atropine rather we required supportive symptomatic treatment.
- Organo-Phosphorous Induced Delayed Neuropathy:

Polyneuropathy due to distal muscle weakness. This also does not respond to oximes or atropine rather we required supportive symptomatic treatment.

Management

- Resuscitative Measures (Airway-Breathing-Circulation).
- Gastric Lavage with 1:5000 KMNO₄
- Activated Charcoal which adsorbs the poison.
- Atropine sulfate arrests the muscarinic effect but does not affect the nicotinic action.
- Should be continued till the Atropinization (Till the Tracheo-Bronchial secretion are clear or dry lung).
- Pupillary status isn't reliable.
- Dose: 2-4 mg IV; Every 10-15 minutes till Atropinization.
- Oximes (PAM) act at Nicotinic sites along with decreasing muscarinic and CNS symptoms.
- MOA- Oximes remove the phosphate group.
- Pyridoxine decreases the requirement of Atropine and so potentiates the action of atropine.

Postmortem Findings

- Signs of Asphyxia
- Congestion of all organs.
- Pulmonary edema
- Blood-stained froth is seen at the mouth and nose (seen in Organophosphorus).
- Kerosene smell due to Aromax (solvent present in pesticides).
- Organophosphorus can be detected in a putrefied body.

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Carbamates

00:20:45

- Reversibly inhibit carboxylic esterase enzymes (AChE) by carbamylation.
- Spontaneously hydrolysed from an enzymatic site within 48 hrs.
- Cannot penetrate CNS.
- Atropine is a specific antidote.
- Oximes are contraindicated.
- Examples- Aldicarb, D-carb, Propoxur, Baygon, Ficam.

Organochlorine

- Ex- Aldrin, Endrin, DDT
- Deposited in fat.
- Endrin is also known as Plant Penicillin & inhibits Gaba Mediated Cl⁻ influx in CNS.
 - Excitatory effect overall
- Endrin is a CNS Stimulant
- Symptoms include Tremors, Myoclonus, and seizure.
- Hyperthermia, mydriasis, and respiratory failure are also seen.

Management

- Resuscitative measures along with gastric lavage activated charcoal.
- No specific Antidote.
- Symptomatic treatment.

Kepona Shake - Tremors of Head, Hand

- Tremor of chronic Organochlorine. Ex- Chlordecone which causes Kepona Shake

Pyrethroids

- Here, we use Mosquito repellents.
- MOA- Inhibits Sodium channel.
- Supportive treatment.

Aluminum Phosphide (ALP)

- Also, known as Celphos.
- Used as a grain preservative having a Garlicky smell / Odor.
- Each 3gm tablet liberates 1 gm of phosphine gas.

- Phosphine has cytotoxic Action by inhibiting an enzyme which is Cytochrome oxidase.
- The chemical reaction is accelerated by HCL presence in the stomach.
 - Fatal dose- 1-3 tablets.
- Liver shows Centrizonal Hemorrhagic Necrosis.
- M/c cause of death is Cardiogenic shock.
- Mortality= 35-100% (high).
- No specific Antidote is given.
- Magnesium Sulfate is given to correct Hypomagnesemia, Arrhythmia.
- Activated charcoal & Liquid Paraffin is used to decrease absorption and increased excretion respectively.

Zinc Phosphide

- Can be used as a Rodenticide.
- Causes slow releases of Phosphine.
- Onset is low.
- Garlic / rotten fish smell.

Inorganic Irritant-Nonmetallic Poison

00:32:00

Phosphorus Poison

- It is a protoplasmic poison.
- Also known as Diwali Poison.

	White	Red
Toxic	Yes	Non
Odor	Garlicky	No
Luminous	Yes	Non
Morphology	Crystalline	No
Inflammable	Yes	Non
Kept underwater	Yes	No

- White+red phosphorous (some)=Yellow Phosphorus (Poisonous)

Use of Red Phosphorus

- For making matchboxes
 - Glass particle + Red phosphorus
- Matchstick
 - Sulfur + (potassium chlorate)

White Phosphorus

- Used in chemical warfare.
- Used for making crackers (mainly)
- Used for making insecticides.
- Used for making Rodenticide.
- In the old time, it was used as Arson for firing the houses or huts.

- For Phosphorous the antidote is CuSO_4 (poisonous)
- Asterixis (tremor).
- Vit. k is used in the treatment.
- Smoking stool syndrome.



- It is a phosphorus burn (high chances when used as crackers)
- Irritant poison leading to Gastroenteritis.
- Accidental Poisoning is very common in children.
- Fatal dose- 60-120 mg.
- Fatal period- 2-8 days.

3 Stages of Phosphorus Intoxication

- First stage:
 - Burning pain in Throat, Stomach, and Abdomen
 - Nausea, vomiting, pain, Diarrhea
 - Seen in 1-2 days of Poisoning.
 - Fatty changes or failure of the liver may be seen.
 - Yellow atrophy of the liver can also be seen.
 - Painful penetrating burn (2nd & 3rd degree).
 - Breath and excreta have a Garlicky odor or smell.
 - Luminous vomiting and faeces are diagnostic.
 - Smoking stool syndrome- white faint fumes coming from stool or faeces.
- Second stage:
 - Asymptomatic
 - Can last for 3-4 days.
- Third stage:
 - Systemic
 - Multi-organ failure.
 - Liver & RBC involved.
 - Flapping Tremor (Asterixis).
 - Kidney failure.
 - Encephalopathy.
 - Jaundice.

Treatment

- Gastric Lavage with KMNO_4 .
- Antidote is CuSO_4 (not used for oral as it's poisonous).
- Vit K is used for treatment.
- FFP is used for treatment.
- Burn should be washed with 1% CuSO_4 .

PM finding

- Garlicky Odor.
- Jaundice.
- PM staining is Dark or chocolate brown P-A-N.
- Yellow liver atrophy.
- Multiple Hemorrhages in mucosa and organ.

Chronic Poisoning

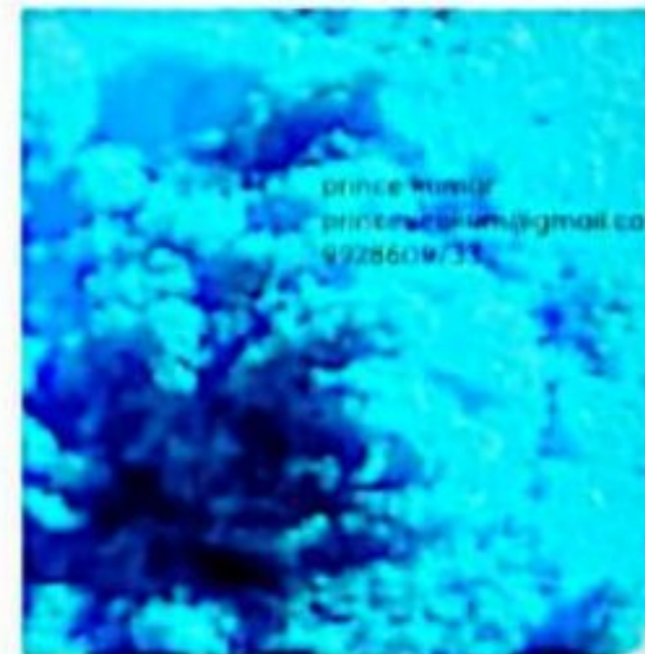
- Common in the matchbox industry while vapor inhalation.
- It causes osteonecrosis of jaw bone
- Phossy jaw or Glass jaw or Lucifer's jaw.
 - It's chronic phosphorus poisoning or osteomyelitis of the jawbone.
 - Symptoms-
 - Tooth in the hold.
 - Pain in the tooth.
 - Swelling in the tooth.
 - Osteonecrosis of the jaw.
 - Multiple discharging sinus.

Inorganic Irritant- Metallic Poison

Copper Poisoning

- Pure copper is not poisonous.
- CuSO_4 aka blue vitriol is poisonous.

CuSO_4



- Copper subacetate / Verdigris
 - Fatal dose- 15gm
- Copper Arsenite → Scheele's Green.
- Copper aceto-arsenite → Paris Green.

Signs and symptoms

- Most of the time, poisoning is accidental.
- Pain in the Throat, Abdomen
- Ptyalism (increased salivation).
- Vomiting (bluish green).
- Hemolysis in RBC, liver, and kidney.
- Chalcosis (Copper depositions in tissue)
 - Chalcosis oculi (Copper deposition in eye)
 - Defective copper metabolism is Wilson Disease (autosomal recessive disease)-sunflower cataract-KF ring is seen in Descemet layer.

- Clapton Lines (Green color lines in gums because of Copper sulfide)
- Hair becomes green.
- Vineyard sprayer's lung disease-
 - It was noticed in Portuguese.
 - Causes interstitial Pulmonary fibrosis.
 - Granuloma is seen in the lung.
 - Exposure of CuSO_4 in vineyards.

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Treatment

- Gastric lavage with 1%.
- Chelating agent of choice which is D-Penicillamine.
- 1% Potassium Ferrocyanide is also used.

Thallium Poisoning (ideal homicidal poison)

- Alopecia is seen after 1-2 weeks of exposure.
- Painful Polyneuropathy resembles GBS.
- Skin rash (Maculopapular rash)- distribution is in a butterfly pattern.
- Sign de sourcil → Lateral 2/3rd of eyebrow are lost.
- Mee's line is also seen.
- Antidote used is Prussian Blue.

Cadmium Poisoning

- Very common in battery, welding industries, water, and contaminated food, smoking.
- Replaces calcium of body → Hypocalcemia → weak, brittle bones & Fracture.
- Spine and leg pain
- Gait waddling
- Disease is known as Ouch-Ouch disease or Itai-itai disease
- Can have PCR necrosis.
- Hair becomes yellowish color.
- Teeth become yellow.
- Chelating agent of choice is DMSA.

Manganese Poisoning

- Features look like Parkinson's Disease.
- Metal fume fever or Smelter fever.
- Inhalation of some metal fumes (Ex- zinc, nickel, copper, antimony, lead, iron, cobalt).
- Symptoms resemble → malaria.
- Symptoms start in 6-8 hrs.
- Symptoms subside in 36 hrs.

Mercury Poisoning

- Also known as Quicksilver
- Hg is used for Mercury.
- Minimata disease, Mercuria-Lentis
- Erethism (psychiatric problem).

- Danberry Tremor (starting).
- Acrodynia
- Chronic mercury Poisoning is known as Hg:
 - Hydra Gyrism
 - Also, known as Hatter Shake.
 - Common in the glass industry and hence known as Glass Blower Shake.

Mercury

- Elemental mercury (thermometer) is not poisonous because it is not absorbed from the GI tract.
- A liquid metal
- Mercuric Compounds are more poisonous than Mercurous compounds
- Acute exposure to elemental mercury vapor is very common among Glass Industry workers.
- Mercuric salt (poisonous) is known as Mercuric chloride or corrosive sublimate.
- Donovan's Solutions used for SDT is a combination of mercury and Arsenic.
- Toxicity → organic mercury (methyl, ethyl) > mercuric salt > Mercurous salt (Mercurous sulfide- Caromal)
- Mercuric sulfide is used in Sindoor in vermilion.
- Lead tetroxide is another poison.
- Mercuric thiocyanate is used for making crackers known as Pharaoh Serpent

Symptoms of Acute Poisoning

- Acrid metallic taste, the feeling of constriction in the throat, difficulty in breathing.
- Corrosive lesions in mouth and tongue showing grayish-white coating.
- Diphtheria-like colitis (diphtheric colitis) & if the patient survives for 1-3 days → PCT, Gingivitis, and membranous colitis is seen.
- Treatment:
 - Gastric lavage with 5% Sodium Formaldehyde Sulfoxylate and Sodium bicarbonate.
 - Sodium Formaldehyde Sulfoxylate is the antidote.
 - Chelating Agent of choice is BAL.

Chronic Poisoning Mercury

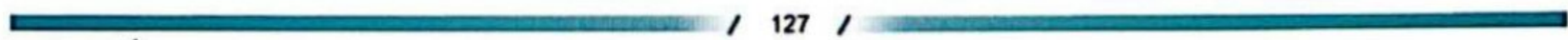
- Chronic poisoning Mercury → Hydra-Gyrism
 - Gingivostomatitis, Erethism, Tremors
- M-Minimata → Seen in Japan (selfish)
 - Disease-Organic (Methyl) Mercury
- E-Erethism (Mad Hatter Syndrome) → Shy depression, Anxiety Loss of confidence, Suicidal
- Danberry Tremor- Coarse, Hand, Lips, Tongue, (Earliest-Worse)
- HG- Hatter's

01-04-18

- Shake (Not able to Dress, Walk)
- Glass-Blower Shake
- **Conussio Mercurialis- Most Severe- Bedridden, No Activity seen**
- **Mercuria lentis** → Hg = Anterior lens capsule → brown color
 - Reflex → Slit examination → Brown malt reflex is seen
 - Visual Acuity → Intact
 - B/L

- **Acrodynia** → also know as pink disease, swift disease caromel ds
 - Puffy-hands & feet
 - Painful
 - Pinkish
 - Pruritus, Perspiration-sweating is seen
 - Peeling of skin, Resemble Kawasaki disease

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22

GENERAL TOXICOLOGY PART - 3 (STARVATION DEATH, ASPHYXANT POISON, AND MISCELLANEOUS LAWS)



Starvation

- Withholding of food and water or administration of unsuitable food leads to starvation.
- **Baby farmer:** Term used to describe any child who is starved by their parents



Causes

- Age.
 - Child starvation occurs in battered baby syndrome.
 - Starvation of the elderly occurs in abuse.
- Sex.
 - Female starvation due to sexual discrimination.
- Trapped.
 - Being trapped in pits, mines, or landfills.
 - Accidental starvation.
- Neglect.
 - May be of children, adults, or the elderly.
- Religious.
 - Religious starvation occurs through mandatory fasting.
- Hunger strike.

Medicolegal aspect

- Accident starvation – most common.
- Suicidal starvation.
- Homicidal starvation.
 - Battered baby syndrome.
 - Elderly abuse.

Fatal starvation

- Death usually occurs when 20% of total body protein is lost.
- 40% of the original weight is reached.
- 70-90% of body fat is lost.

Fatal period

- If completely withdrawn from both food and water → Death in 10-12 days.
- If only food is withdrawn → Death in 6-8 weeks.
- Newborns may survive for 7-10 days without food and water.

Postmortem findings

- Extreme emaciation and the general reduction in size and weight of all organs, except the brain.
- Gall bladder is distended with bile.
- Brown atrophy of the heart.
- Rigor mortis sets in and disappears early.
- Face is pale with inelastic and pigmented skin.
- Ankle edema.
- Fat is completely absent in subcutaneous tissue sparing the female breast and orbit.
- Stress fracture due to demineralization and osteomalacia.
- Wall of the intestine appears like tissue paper with atrophy of mucosa and all layers are also bile stained.

Asphyxiant

00:06:43

Gases that cause asphyxia

- Carbon monoxide.
- Cyanide.
- Hydrogen sulphide.

Carbon monoxide (CO)

- Colorless.
- Odorless.
- Lighter than oxygen.
- No irritation.
- 40x more affinity for myoglobin than oxygen.
- 210x (200-300x) more affinity for hemoglobin than oxygen.
- Shift the oxygen dissociation curve to the left side.
- Anemic anoxia or anemic hypoxia.
- Anaerobic metabolism leads to lactic acid formation and high anion gap metabolic acidosis.

CO poisoning

- May be accidental or suicidal.
- Accidental reasons:
 - Car engine.
 - Chimney.
 - Heater, especially gasoline.

CO poisoning symptoms

- CO automatism.
 - Erratic movements of the dying victim inside the room, disturbing clothing and furniture which indicate a violent struggle.
- Upper limit of safety is 0.01% CO in the air.

CO concentration	Symptom
10-20%	<ul style="list-style-type: none"> • Headache. • Muscle weakness.
20-30%	<ul style="list-style-type: none"> • Throbbing headache. • Dyspnea. • Emotional irritability
30-40%	<ul style="list-style-type: none"> • Dizziness. • Disorientation. • Judgmental impairment.
40-50%	<ul style="list-style-type: none"> • Similar to alcoholic drunkenness'. • Ataxia. • Hallucination. • Disorientation. • Slurred speech.
50-60%	<ul style="list-style-type: none"> • Syncope. • Coma. • Convulsion. • Myocardial infarction. • Arrhythmia.
60-70%	<ul style="list-style-type: none"> • Coma. • Death.
>70%	<ul style="list-style-type: none"> • Death.

CO poisoning treatment

- 100% high-flow oxygen until carboxyhemoglobin falls to 15-20%.
- Hyperbaric oxygen.
 - Barotrauma is a side effect.

**Important Information****Rebound toxicity of CO**

- Oxygen exposure to carboxyhemoglobin (CO-Hb) leads to CO binding with myoglobin.
- CO diffusion into the blood at a later stage leads to the reformation of Co-Hb.

CO poisoning tests

- Hoppes-Seyler's test.
- Kunkel test.
- Spectroscopy.
- Wetzel test.
 - Discontinued.

PM findings in CO poisoning

- Cherry-red post-mortem staining.
- Blisters in dependent or frictional areas.
 - Axilla, buttocks, inner thigh, calves, wrists, and knees.
 - Also seen in barbiturates poisoning.
- Bilateral and symmetrical necrosis and cavitation.
 - Seen in globus pallidus and putamen i.e., basal ganglia change.

Cyanide

- Produced in apple, apricot, peach, plum, almond, and linseed.
- Liquid cyanide → Hydrocyanic acid or Prussic acid.
- 4% cyanide in water → Scheele's acid.
- Gas → Cyanogen or Hydrogen cyanide.
- Bitter almond smell.
 - Smell perception is a sex-linked recessive trait.
- Ideal for suicidal poisoning.
- Salts such as KCN and NaCN are non-toxic.
 - Combine with hydrochloric acid in the stomach to form HCN that is absorbed.
- No effect in achlorhydric individuals.

Mechanism of action

- Has an affinity for ferric ions Fe^{3+} .
- Binds with cytochrome C oxidase (complex IV of electron transport chain).
- Cell cannot utilize oxygen leading to histotoxic/cytotoxic anoxia.
- Anaerobic metabolism leads to lactic acid formation and high anion gap metabolic acidosis.

Cyanide poisoning signs and symptoms

- Inhalation → Dizziness, vertigo, and constriction of the throat.
- Ingestion → Nausea, headache, loss of muscular power, hypotension, cardiovascular failure, and convulsion.
- Death occurs from respiratory failure.

Uses of cyanide

- Electroplating.
- Fumigation.
- Goldsmith.
- Photography.

Cyanide poisoning treatment

- Remove the exposure source and clothes (avoid absorption through the skin).
- Vitamin B12 → Best antidote.
 - Hydroxocobalamin combines with cyanide to form CN-cobalamin that is excreted.
- ELI-LILLY antidote.
 - Triple antidote.
- Amyl Nitrite inhalation.

- IV Sodium nitrite.
- Sodium thiosulphate is 50%.
- Sodium bicarbonate.
 - Correction of acidosis.
 - IV methylene blue used in severe conditions.
 - Para-aminopropiophenone (PAPP) can also be used.



Important Information

Amyl Nitrite, sodium nitrite, and 50% sodium thiosulphate

- Conversion of hemoglobin to methemoglobin that combines with cyanide to form cyanmethemoglobin.
- Sodium thiosulphate combines with cyanmethemoglobin to form water-soluble thiocyanate that is excreted in the urine.

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Post-mortem findings

- Brick-red or bright red staining.
- Bitter almond smell.

Cyanide poisoning test

- Lee-Jones test.

Hydrogen sulphide

- Formed during the decomposition of organic substances containing sulphur.
- Rotten egg smell.
- Knock-down gas → Sudden loss of consciousness.
- Also known as sewer gas.
- Detergent suicide phenomenon is seen in Japan.
 - Bath salt containing sulphur combined with toilet bowl cleaner containing hydrochloric acid.

Management

- Hyperbaric oxygen and nitrites → Antidote.



Important Information

- Hydrogen sulphide acts on **Cytochrome C oxidase** (Complex IV of electron transport chain).

Miscellaneous laws

00:30:51

Juvenile Justice Act

- Any child < 18 years.
- Age decided by birth certificate, physical appearance, and medical examination.
- Functions:
 - Punishment for cruelty against a child.
 - Juvenile justice board formed to deal with juveniles who have committed crimes.
 - 3 members of the juvenile justice board:
 - 1st class judicial magistrate.
 - 2 social workers (one should be female).

Punishment of juveniles

- Normal offense → <3 years in a juvenile home or rehabilitation center.
- Serious crimes → 3-7 years.
- Heinous crimes → >7 years.
- Children between 16-18 years who have committed a heinous crime e.g., rape or murder will be sent for psychiatric assessment and tried as an adult.
- Other orders:
 - Counselling.
 - Fines.
 - Special homes.
 - Community service.

Consumer Protection Act 2019

- Amendment made in 2019, with the original proposed in 1986.
- Came into action on 20th July 2020.

Redressal Commission

- District → 1 crore compensation.
- State → 1-10 crores.
- National → >10 crores.
- Appeal in Supreme Court.

Time limitation

- Case should be filed within 2 years.
- Appeal heard within 45 days (after district).
- Next appeal is heard within 30 days (after state).
- Case completion time – 3 months.
- Case completion time if there are any lab tests – 5 months.
- Appeal completion – 90 days.

Important features

- E-filing of complaints.
- E-commerce sites included.
- Misleading advertisement.
- Forum conversion to the commission.
- Time limitation increased from 30 days to 45 days.
- Central consumer protection authority established.

Rights of consumer

- Information.
- Protection.
- Assurance.
- Heard.
- Awareness.
- Redressal.

Protection of Children from sexual offense (POSCO) act-2012

- Last amendment in 2019.
- Applicable for ages < 18 years.
- Evidence of the child to be recorded within a period of 30 days and completion of trial within a period of one year, as soon as possible.

Sexual harassment

- Bullying or coercion of a sexual nature and the unwelcome or inappropriate promise of rewards in exchange for sexual favors.
- Includes:
 - Sound and gesture, and exhibiting an object.
 - Child pornography or showing child pornography.
 - Making the child exhibit a body part or showing his body part.

Sexual assault

- Act in which a person intentionally:
 - Sexually touches another person without their consent.
 - Coerces or physically forces a person to engage in a sexual act against their will.
- No penetration.
- Hormone administration.

Penetrative sexual assault

- Penetrate the penis into any orifices of a child or any object into the:
 - Vagina, urethra, or anus.
 - Applies mouth (body part) to the penis, vagina, urethra, or anus of a child.

Aggravated penetrated sexual assault.

- Sexual assault by:
 - Two or more than two people.
 - Relatives.
 - Age of child < 12 years.
 - Armed forces.
 - Insane/Institutionalized child.
 - Trusted or having authority.
 - Officer
 - Repeat offender.
- Done by:
 - Police officer.
 - Armed/Security forces.
 - Public servant.
 - Management/Staff of jail, remand home, protection home.
 - Hospital staff.
 - Staff of educational or religious institutes.
 - Gang.
- Involves:
 - Using deadly weapons.
 - Causing grievous hurt.
 - Making a child mentally ill or pregnant or HIV positive.
 - Act done on disabled children or pregnant children.
 - With an attempt to murder or during communal violence.
 - By guardian, repeatedly on the same child.
 - Child aged < 12 years.

POSCO offenses and punishment

Offense	Punishment (POSCO-2012)	Punishment (POSCO-2019)
Penetrative sexual assault	7 years to life imprisonment plus a fine.	If a child is below 16 years, 20 years to a life term plus fine.
Aggravated penetrative sexual assault	10 years to life imprisonment plus a fine.	20 years to the death penalty plus a fine. It adds two more grounds to the list for aggravated sexual assault. <ul style="list-style-type: none"> • Assault resulting in the death of a child. • During natural calamity.
Sexual assault without penetration	3-5 years imprisonment plus a fine.	Same.
Aggravated sexual assault without penetration	5-7 years imprisonment plus a fine.	Adds two more offenses: <ul style="list-style-type: none"> • During natural calamities. • Administering any chemicals or hormones for cervical maturity.
Sexual harassment	0-3 years imprisonment plus a fine.	Same.
Use of child for pornographic purposes	0-5 years imprisonment (7 years for subsequent offense) plus a fine.	Minimum 5 years imprisonment.
Storage of children for pornography	0-3 years plus fine.	Adds two more offenses: <ul style="list-style-type: none"> • Failure to destroy or delete such. • Mode for transmitting.

Human organ transplantation act (HOTA-1994)

- Transplantation of human organs and tissues act (THOTA-2014).
- Deals with removal, storage, and transplantation.
- Prevent commercial dealing.
- Human organ definition.
 - Any part of the human body (structured arrangement of tissue) that, if removed, cannot be replicated in the body.

Brain stem death declaration by doctor

- Can be done by:
 - Treating a doctor.
 - In-charge doctor.
 - Neurologist or neurosurgeon.
 - Intensivist, anesthetist, or physician.
 - Independent specialist authorized by the government.

Checklist for brain death

	CN	Center
Light reflex	2,3	MB
Vestibulo-ocular	3,6,8	MB/P
Dolls eye	3,6,8	MB/P
Corneal	5,7	P
GAG	9,10	Medulla
Apnoeic	Respiratory center	Medulla

- MB-midbrain, P- pons.

Donations type

Living donation.

- Near relatives i.e., parents, son, daughter, brother, sister, grandparents, and grandchildren.
- Non-relatives → Prior approval from any authorized committee.
- Swap transplantation between unmatched pairs.

Cadaveric donation.

- Authorized by:
 - Any donor above 18 years and of sound mind.
- Will written before death instructing for transplantation in the presence of two witnesses.
- Consent needed for legal possession of body given:
 - If there was no will.
 - Unknown dead body for more than 48 hours done by doctor or in-charge.
 - In medicolegal case requires approval from the autopsy surgeon.

Most commonly donated organs

- Heart.
- Liver.
- Thymus.
- Intestine.
- Lungs.
- Kidney.
- Pancreas.

- Most common: Kidney > Liver > Heart.

Most commonly donated tissues

- Bone.
- Cartilage.
- Cornea.
- Middle ear.
- Veins.
- Valves.
- Skin, tendon, and ligament.
- Most common: Cornea > Bone > Tendon.

Punishment

Human organ/tissue transplantation without authorization

- 10 years plus 20 Lakhs fine.
- Applicable for medical staff and paramedical staff.

Additional punishment for the doctor

- The State medical council nullifies registration.
- 1st offense → 3 years.
- Subsequent offense → Penal erasure or professional death sentence.

For commercial dealing

- 2-7 years plus a fine.

Medical certification of cause of death (MCCD)

00:59:19

- MCCD issued by a doctor.
- Death certificate issued by the registrar or sub-registrar of state government.
- Doctor's duty in MCCD:
 - Diagnose the person as dead.
 - Declare death.
 - Conclude the cause of death.
 - Certify the cause of death.

Cause of death

- Reason someone dies.
- Underlying/Primary cause.
 - Disease or injury that initiated events.
 - Example: Diabetes mellitus.

Antecedent/Intermediate cause. (Part-1)

- Occurs sometime between primary and immediate causes.
 - Example: Gangrene.
- Immediate cause.
 - Final complication due to disease or injury.
 - Most recent event that occurred before death.
 - Example: Septicemia.
- Diabetes mellitus (primary cause) → Gangrene (intermediate cause) → Septicemia (immediate cause).
- Underlying/Primary cause written in mortality statistics.

FORM NO. 4A
(See Rule 7)
MEDICAL CERTIFICATE OF CAUSE OF DEATH
(For non-institutional deaths. Not to be used for still births)
To be sent to Registrar along with Form No. 2 (Death Report)

I hereby certify that the deceased Shri/Smt./Km..... son of/wife of/daughter of resident of was under my treatment fromto and he/she died on at AM/PM.

NAME OF DECEASED					For use of Statistical Office
Sex	Age at Death				
	Age in completed years	If less than 1 year age in months	If less than one month age in Days	If less than one day, age in Hours	
1. Male 2. Female					
CAUSE OF DEATH					Interval between on set & death approx.
I Immediate cause State the disease, injury or complication which caused death, not the mode of dying such as heart failure, asthenia etc.		(a) Due to (or as a consequences of)			
Antecedent cause Morbid conditions, if any, giving rise to the above Cause, stating underlying condition last		(b) Due to (or as a consequences of)			
II Other significant conditions contributing to the death but not related to the disease or conditions causing II		(c)			

If deceased was a female, was pregnancy the death associated with? 1. Yes 2. No
If yes, was there a delivery? 1. Yes 2. No

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Cause of death		Approximate interval between onset and death
I Disease or condition directly leading to death* Antecedent causes Morbid conditions, if any, giving rise to the above cause, stating the underlying condition last	(a)
	due to (or as a consequence of)	
	(b)
	due to (or as a consequence of)	
	(c)
	due to (or as a consequence of)	
	(d)
<hr/>		
II
Other significant conditions contributing to the death, but not related to the disease or condition causing it
<i>*This does not mean the mode of dying, e.g. heart failure, respiratory failure. It means the disease, injury, or complication that caused death.</i>		

Contributory conditions (Part II)

- Not related to disease but contributed to the death.
- Unfavorable conditions.



Important Information

Example

- Rupture of the myocardium – immediate cause.
 - Myocardial infarction.
 - Coronary artery thrombosis.
 - Atherosclerosis.
- Part II-Smoking, Chronic obstructive pulmonary disease (COPD), Diabetes mellitus.

RBD ACT-10(3)

- Registration of Birth and death act.
- Obligatory for registered medical practitioners (RMP) who attended a patient's last illness.
- No fee charged for the cause of death.
- Cause of death given instantly.
- Certification of cause done by RMP.

174(3) CRPC

- Police inquest.
- Police are unable to identify the cause of death and refer to the doctor to conduct a postmortem.

MCCD (4A) and Death report (2)

- MCCD form 4A.
- Death report form 2.
- Both forms are sent to the registrar or sub-registrar of the state government to assign a death certificate within 21 days.
- If a patient is already dead when they are brought to the hospital, only form 2 is sent and the doctor informs the police.
 - Post-mortem is conducted to determine the cause of death.
 - No form 4A.



- Study of death.
- Death comes under - S.46 IPC
- Taphonomy is the study of post-mortem changes.
- Components of Bishop's tripod of life:
 - Heart- circulation.
 - Lung - respiration.
 - Brain function.

Types of Death

00:01:44

Somatic death or Clinical death

- Complete and irreversible stoppage of any of Bishop's tripod of life components.
- A loss of one function leads to death.
- Doctor declares the individual dead.

Molecular death or Cellular death

- Occurs 1-2 hours after somatic death.

Supra-vital interval

- Time period between the occurrences of somatic death followed by molecular death.

Bichat's mode of death

- Depends on the dysfunction i.e., may be respiratory, circulatory, or brain function.
- Dysfunction of respiration → Asphyxia.
- Dysfunction of circulation → Syncope.
- Dysfunction of brain function → Coma.
- Asphyxia, syncope, and coma are examples of Bichat's mode of death.

Atria mortis or Gateway of death

- Stoppage of only one component of Bichat's tripod of life (respiration, circulation, or brain function) results in death.
- Example of somatic death.

Suspended animation or Apparent death.

- Signs of life are reduced to a minimal level.
- Resuscitation leads to survival.
- Causes of suspended animation:
 - Prolonged anesthesia.
 - Newborn (most common).
 - Barbiturates poisoning.
 - Cholera.
 - Cachexia.
 - Concussion.
 - Drowning.
 - Electrocutation.

- Hypothermia.
- Hyperthermia.
- Sunstroke.
- Shock.
- Insanity.
- Trance (voluntarily suspended animation seen in yoga practitioners).
- Typhoid (enteric fever).
- Morphine overdose.

Zasko's phenomenon or Tendon reaction

- Occurs 1-2 hours after somatic death.
- Seen during the supra-vital interval.
- Definition-Striking the lower one-third of the quadriceps femoris muscle with a hammer causes upward movement of the patella.
- Organ harvesting for transplantation.
- Done during the supra-vital interval.

Post-mortem changes

00:11:09

- Signs of death may be immediate, early, or late.

Immediate signs

- 1st sign is insensibility (loss of sensation) and loss of voluntary power.
- Stoppage of respiration and circulation.

Late signs

- Decomposition signs.
- Putrefaction.
- Autolysis.
- Mummification.

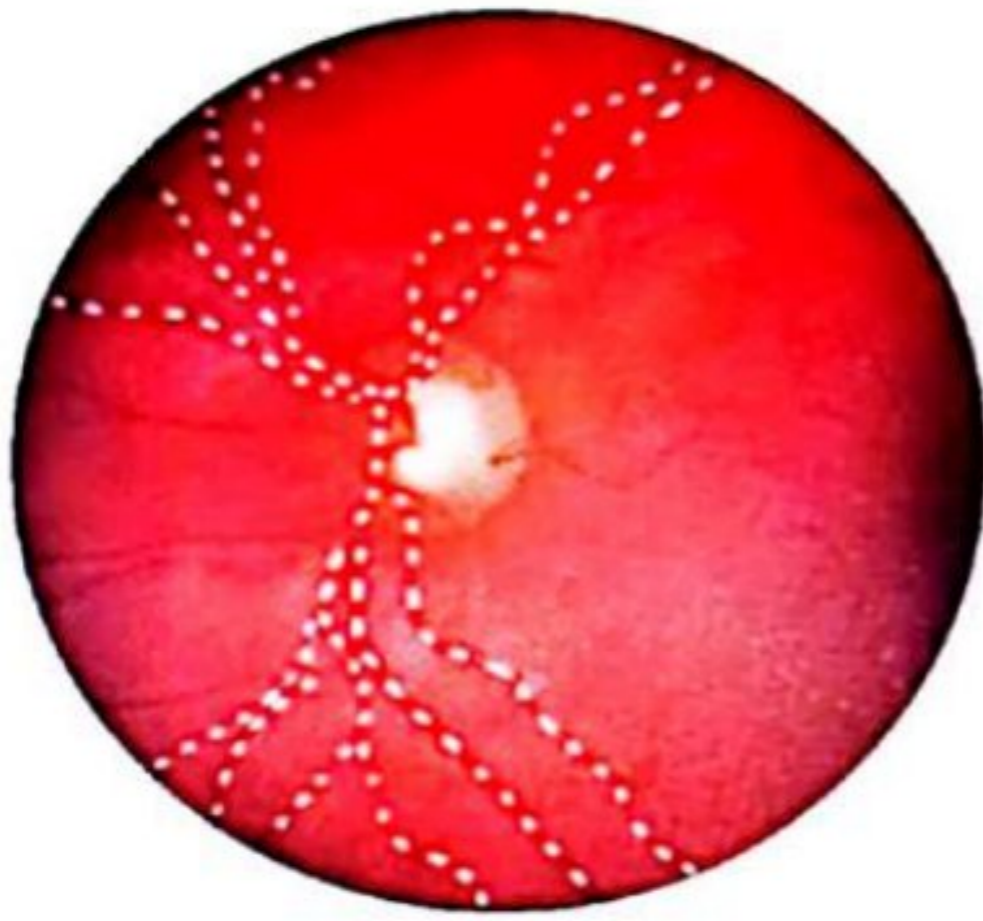
Early signs

- Eye changes.
- Algor mortis.
- Livor mortis.
- Rigor mortis.

Eye changes

Railroading phenomenon or cattle trucking or Kevorkian sign.

- Retinal blood vessels appear segmented or fragmented.
- Seen within a few minutes to one hour after death.
- Seen using an ophthalmoscope.
- Earliest eye sign.
- Used to determine time since death (TSD).
- Before the Kevorkian sign, corneal reflexes are lost, and the pupil is dilated.



Kevorkian sign

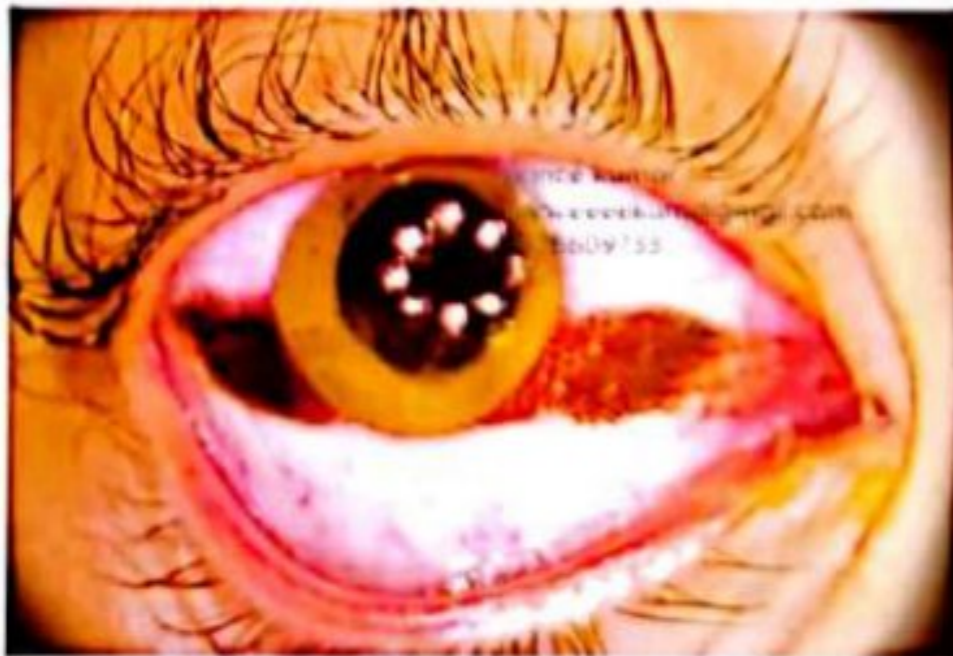
Flaccidity of the eyeball.

- Normal intraocular pressure is 20mmHg.
- Two hours after death, intra-ocular pressure drops to 0 mmHg.
- Used to determine time since death.

Tâche noire sclérotique.

- Change in the sclera.
- Occurs after 3-6 hours post-mortem.
- Triangular area composed of cell debris and mucus with color change from yellow to brown or black.
- Used to determine time since death.

Tache- Noir

**Corneal changes.**

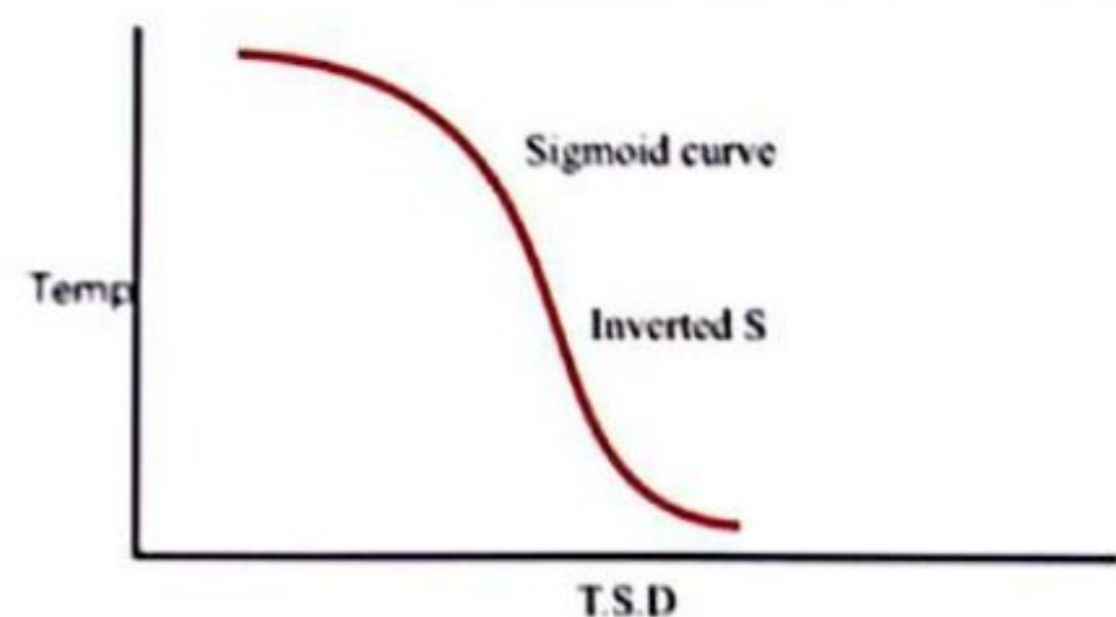
- Hazy cornea occurs after 1 hour.
- Opacity of cornea occurs after 6 hours.

Vitreous humor changes.

- **Resist putrefaction** i.e., no chemical changes in vitreous humor after putrefaction.
- Linear increase in K^+ and hypoxanthine.
- Decrease in glucose.
- Best for determining time since death.
- Formulas used to determine K^+ content include:
 - Sturner's formula.
 - Madea's formula.

Cooling of the body or Algor mortis

- Seen within 15 minutes after death.
- Core body temperature (CBT) decreases.
- Thanatometer is a chemical thermometer used to measure core body temperature -.
 - It may be 25-30 cm.
 - It can measure temperatures between 0-50°C.
- Ideal site for recording temperature is the rectum (rectal temperature is almost equal to core body temperature).
- Other sites include the inferior surface of the liver, external auditory meatus, nasal spaces, and the lower end of the esophagus.
- Graph illustrating the relationship between temperature and time post-mortem produces a sigmoid curve or inverted S-shape curve.



- Stage I: Isothermic phase.
- Stage II: Steep decline.
- Stage III: Gradual decrease.

Rate of fall

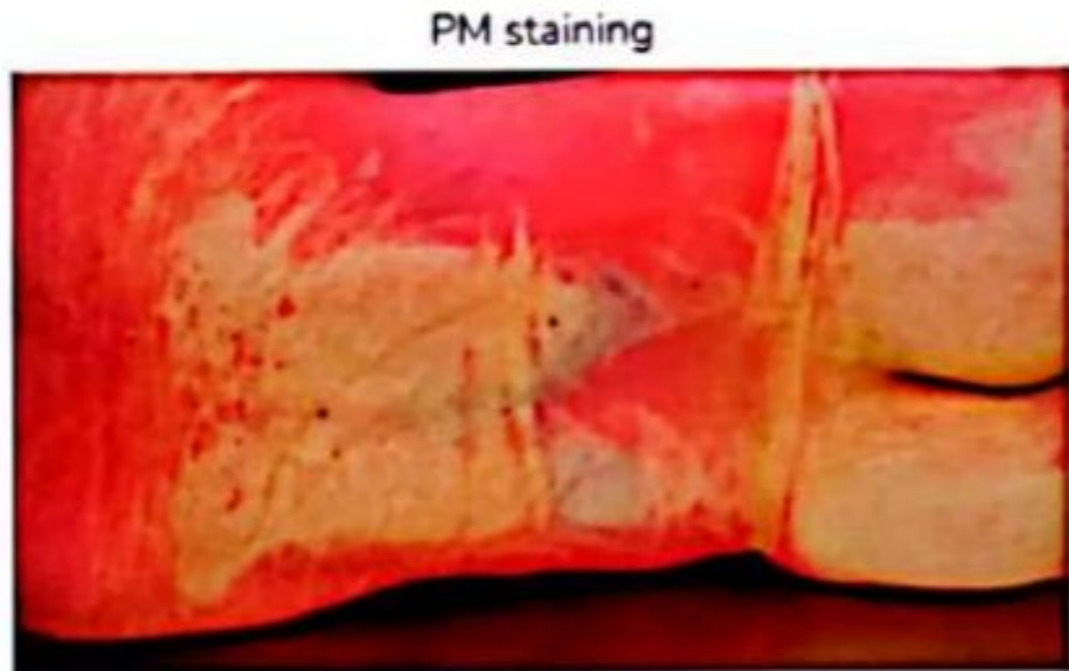
- TSD → Time since the death.
- NBT → Normal body temperature.
- ROF → Rate of fall.
- RT → Rectal temperature.
- Rate of fall in temperature post-mortem is 0.4°C-0.6°C/hour or 0.75°F-1.5°F/hour.
 - 0.4°C/hour in summer.
 - 0.6°C/hour in winter.
 - Average rate of fall is 0.5°C/hour $TSD = (NBT-RT)/ROF$

Post-mortem caloricity

- Temperature increases for 1-2 hours after death.
- Causes include:
 - Septicemia (cholera, typhoid).
 - Sun stroke (pontine hemorrhage).
 - Strychnine poisoning (tetanus, exercise).
- In septicemia, there is increased bacterial activity.
- In sunstroke, heat regulation interferes.
- In strychnine poisoning, there is increased muscle activity.

Post-mortem staining

- Also known as post-mortem lividity, hypostasis, livor mortis, vibices, or suggilation.
- Present in dependent parts of the body i.e., areas that do not touch the ground but face towards the ground.



- Gravitational forces cause the pooling of blood in capillaries and venules.
- Accumulation of deoxyhemoglobin blood in the skin causes a bluish-purple appearance.
- Skin discoloration of rete mucosum of the dermis.
- Absent in pressure parts of the body.
- Begins shortly after death i.e., 30 minutes.
- Visible in 2 hours after death.
- Maximum visibility for 6-12 hours.
- Fixation occurs after 7-8 hours.
- Secondary lividity occurs when changing the position of the body before 7-8 hours leading to post-mortem staining in other areas of the body.
- Persists till decomposition.
 - Decomposition changes the skin color to green.

PM staining

Begins	= Shortly After Death = 30 min
Visible	= 2 hr
Maximum	= 6-12 Hrs
Fixation	= 7-8 Hrs
Persist	= Decomposition = Skin Green

Post-mortem staining in different positions

- Supine position → back of the head, back of the neck, back of the chest, back of the leg.
- Prone position → front parts of the body.
- Hanging position → hands and feet i.e., glove and stocking pattern.
- Running water → no post-mortem staining.

Medical importance

- Determines time since death.
- Determines the position of the body at the time of death.
- Determine the cause of death (COD).

Color presentation due to different causes

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- Carbon monoxide poisoning → Cherry-red.
- Cyanide poisoning → Bright or brick red.
- Hypothermia → Pink.
- Hydrogen sulphide (H₂S) → Blue green.
- Opium → Black.
- Phosphorous or potassium chlorate (KClO₃) → Chocolate brown.
- Nitrites, nitrobenzene, aniline → Chocolate brown.
 - Aniline may produce a blue color.
 - Chocolate brown color formed due to methemoglobin.
- Clostridium perfringens → Bronze.
- Methanol poisoning → Purple.

Rigor Mortis or Cadaveric stiffening or Cadaveric rigidity

00:40:10

- 3 stages muscles undergo after death include:
 - Primary flaccidity phase or primary relaxation phase.
 - Rigor mortis.
 - Secondary flaccidity phase or secondary relaxation phase.
- Primary flaccidity occurs during somatic death.
- Rigor mortis occurs during cellular death.
- Mechanism of rigor mortis is ATP depletion.
- Actin-myosin separation takes place in primary flaccidity.
- Lack of actin-myosin separation causes rigor mortis.
- Secondary flaccidity occurs when decomposition starts.
 - Actin and myosin filaments are broken down leading to separation.
- When rigor mortis starts, ATP decreases to 85% of the normal content.
- At maximum rigor mortis, ATP decreases to 15-30% of the normal content.
- Rigor mortis refers to muscle stiffening, some shortening, and opacification of the fibres.



Occurrence of rigor mortis in muscles

- Begins 1-2 hours after death.
- Seen in all muscles were voluntary or involuntary.
- 1st muscle affected is the myocardium.
- 1st external muscle affected is the upper eyelid muscle i.e., orbicularis oculi.
- Sequence in which external muscles are affected:
 - Eyelid muscles → Neck → Lower jaw → Muscles of face → Muscles of chest → Upper limbs → Abdomen → Lower limbs → Fingers and toes

Nysten Law

- Rigor mortis develops from the upper parts of the body towards the lower parts of the body.

Shapiro's Law

- Rigor mortis develops in all muscles at the same time.
- This law has been disproven.

Same order

- Rigor mortis disappears in the same order that it appears.
- It will disappear first from the upper eyelid and last from the fingers and toes.

Rule of 12

- In the first 12 hours after death, rigor mortis appears in all body muscles.
- In the next 12 hours, it persists in all body muscles.
- In the next 12 hours, it disappears from all body muscles.
- Rigor mortis appears and disappears within 36-48 hours after death, thereby aiding in the determination of time since death.

Rigor mortis in a fetus

- In fetuses < 7 months of age, rigor mortis is absent.
- Actin and myosin filaments have not developed.
- Rigor mortis appearance according to seasons
- In summer, it is seen in 18-36 hours.
- In winter, it is seen 24-48 hours.

Rigor mortis appearance in wasting diseases.

- Muscle mass is thin with decreased ATP storage.
- Diseases such as cholera, TB, cancer, cachexia, and typhoid.
- Early onset of rigor mortis with short duration.

Rigor mortis appear in violent death.

- Cases such as cutthroat injury or firearm injury.
- Early onset rigor mortis with short duration.

Exceptions

- Strychnine poisoning → Early onset rigor mortis with long duration.
- Arsenic poisoning → Late onset rigor mortis with long duration.

Rigor mortis appearance in thick muscle

- Increased ATP storage.
- Late onset rigor mortis.

Causes of muscle stiffening after death

1. Rigor mortis.
2. Heat stiffening.
3. Cold stiffening.

4. Gas stiffening.
5. Cadaveric spasm.

Heat stiffening

- Also known as boxing attitude or pugilistic attitude or fencing attitude.
- Surrounding external temperature is $\geq 65^{\circ}\text{C}$.
- Mechanism involves the coagulation of muscle protein.
- Normal rigor mortis is not seen.
- Persists till decomposition occurs.

Cold stiffening

- Surrounding external temperature is $\leq -5^{\circ}\text{C}$.
- Mechanism involves freezing of the body fluid and hardening of the subcutaneous tissue.
- In warm temperature, cold stiffening disappears.
- Normal rigor is present.

Gas stiffening

- Mechanism involves the release of gas during decomposition.

Cadaveric spasm

- Also known as cataleptic rigidity or instantaneous rigor.
- Mechanism involves ATP depletion.
- Muscle contracted during life remains rigid and stiff after death.
- Occurs immediately after death.
- Primary relaxation is absent.
- Secondary relaxation is present.
- An exclusively ante-mortem event.

Cadaveric Spasm



- Causes of cadaveric spasm:
 - Asphyxial death.
 - Brain injury.
 - Cerebral injury.
 - Drowning.
 - Dinitrocresol poisoning.
 - Excitement.
 - Fear.
 - Firearm e.g., in suicide.

00:53:10

Differences between cadaveric spasm and rigor mortis

	Cadaveric spasm	Rigor mortis
Time	Immediately after death.	1-2 hours after death.
Muscles	Mainly involves voluntary muscles. Generally, involves a short group of muscles e.g. hand muscles.	Involves both voluntary and involuntary muscles.
Primary relaxation	Absent.	Present.
Molecular death	Absent.	Present.
Electric stimuli	Response present.	Response absent.
Importance	Describes the manner of death.	Determines time since death.

Decomposition

01:02:41

- Two mechanisms: autolysis and putrefaction.

Autolysis

- Body enzymes cause cell lysis.
- Examples of autolytic changes:
 - Clouding of cornea- 1st external change.
 - Changes in brain glandular tissue- 1st internal change.
- Aseptic autolysis involves the mummification of the fetus in intra-uterine death.

Putrefaction

- Stimulated by bacterial activity.
- Most common bacteria involved is *Clostridium welchii* or *Clostridium perfringens*.
- Most common enzyme involved is lytic lecithinase
- Three stages of change:
 - Color change.
 - Gas formation.
 - Liquefaction of tissue.

Colour change

- 1st internal/overall change of putrefaction is reddish-brown discoloration of aortic intima.
- 1st external change is green discoloration of the right iliac fossa.
- Mechanism:
 - Bacteria forms hydrogen sulphide.
 - Cecum located beneath the right iliac fossa has maximum bacterial activity.
 - Skin lies superficial to the cecum.
 - Sulphur combines with hemoglobin to form a green color compound.
- In summer, discoloration starts in 12-18 hours.
- In winter, discoloration starts in 1-2 days.

Decomposition-Green Discolouration of Body



Marbling

- Discoloration of prominent superficial veins to green-brown color.
- Corresponds to the vascular channel.
- Mechanism: *Clostridium welchii* bacteria form hydrogen sulphide gas in the superficial veins with the formation of green, brown sulphahemoglobin.
- Starts in 24 hours.
- Prominent in 36-48 hours.
- Helps in determining time since death.
- Seen in the chest, shoulder, abdomen, and thigh.

Marbling



Filigree burn.

- Lightning injury.
- Pink discoloration.

Does not correspond to the vascular channel.

Maggots

- Larvae of flies i.e., *Musca domestica* or *Musca vicina*.
- Forensic entomology deals with the study of maggots and flies at different stages.
- Developmental stages of flies:
 - Maggots -larvae, seen on the body after 1-2 days.
 - Pupae -seen on the body after 3-6 days.
 - Adult flies.
- Complete development of an adult fly from its larval form takes 5-10 days.
- In winter, it takes 8-20 days.
- Maggots are first seen in the natural orifices.
- In cases of poisoning, poison can be detected in the maggots and pupae i.e., forensic entemo-toxicology.
- Important criteria in deciding time since death.
- Maggot staging was proposed by Megnin.

Maggots



Post-mortem purge

- Gas formation during decomposition leads to the expulsion of blood-stained froth and gastric contents from the nose and mouth.
- Seen after 2-3 days.

Post-mortem luminescence

- Body emits light after death.
- Causes:
 - Bacterial e.g., photobacteria presence.
 - Fungal e.g., Armillaria, Ram's bottom.

Time sequence of significant changes

- Gas stiffening and post-mortem purge → 2-3 days
- Uterine and anal prolapse → 2-3 days.
- Loose hair and nails → 3-5 days.
- Skin peeled off → 3-5 days.
- Pattern: skin peeling starts in the hands and legs i.e., glove and stocking pattern.
- Colliquative putrefaction i.e., liquefaction of tissue → 5-10 days.

Putrefaction sequence

- 1st organs to decompose are the larynx and trachea due to their direct contact to air.
- Followed by (in order):
 - Stomach, spleen, and small intestine.
 - Liver and lung.
 - Brain, heart, kidney, uterus.
 - Skin, muscle, tendon, bone/tooth.
- Non-gravid uterus is the last organ to decompose in females.
- Prostate is the last organ to decompose in males.
- The overall last organ to decompose is bone/tooth.

Important points of putrefaction

- Liver shows gas formation up to 24-36 hours i.e., foamy liver or honeycomb liver.
- Optimum temperature for decomposition is 21-38°C.
- Decomposition starts at > 10°C.
- Poisons inhibiting putrefaction include:
 - Strychnine.
 - Metallic poison e.g. arsenic, antimony, thallium.

- Carbon monoxide.
- Cyanide.
- Carbolic acid.
- 1st amino acid that disappears from bone in decomposition is proline.
- 2nd amino acid to disappear is hydroxyproline.
- Last amino acid to disappear to glycine.
- Bones that are 100 years old have < 7 amino acids.

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Caper Dictum

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- Formula proposed by Taylor.
- Shows the relationship between the rate of decomposition in air, water and soil (earth).
- Air > Water > Earth.
- If decomposition in the air takes 1 week, it will take 2 weeks in water and 8 weeks in soil.
- Air has the fastest rate of decomposition.

Modification of Putrefaction

Adipocere or saponification or grave wax

- Seen in warm, humid climates or if the body is immersed in water.
- Clostridium welchii bacteria.
- Intrinsic lipase enzyme.
- Sites include the face, breast, buttocks, and abdomen i.e., fatty areas.
- Mechanism: Fat is converted to fatty acids that undergo hydrolysis and hydrogenation in the presence of lipase to combine with Ca²⁺ or NH₄⁺ to form soap.
- Ammonical, offensive or sweetish smell like a rancid butter.
- The smell propagates to the clothes of the autopsy surgeon i.e., pseudosmell.
- Two types of adipocere:
 - Fresh - soft, moist, white, greasy.
 - Old - dry, hard, brittle, yellow.
- Time required for adipocere formation is 3 days to 3 months.
- Absent in fetus < 7 months.

Adipocere



- Medical importance:
 - Describe the climate at time of death.
 - Determination of time since death.
 - Preservation of dead body for easy identification.

Mummification

- Seen in dry and hot climates leading to dehydration of the body.
- Natural features of the body preserved.
- 60-70% of body weight is lost.
- Time required for mummification is 3 months to 12 months.
- Arsenic and antimony favors the mummification.
- Important feature of intra-uterine death.



- Medical importance:
 - Describes climate at the time of death.
 - Determination of time since death.
 - Identification is comparatively very easy.

Embalming or Thanatopraxia

- Used to preserve dead bodies.
- Should be used within 6 hours of death.

Composition of embalming fluid

Preservative	<ul style="list-style-type: none"> • Formalin. • Formaldehyde. • Methanol.
Antiseptic/Germicide	<ul style="list-style-type: none"> • Phenol.
Wetting agent	<ul style="list-style-type: none"> • Glycerine. • Glycerol.
Anticoagulant	<ul style="list-style-type: none"> • Sodium citrate.
Buffer	<ul style="list-style-type: none"> • Sodium bicarbonate. • Sodium carbonate. • Sodium chloride.
Vehicle	<ul style="list-style-type: none"> • Water.

- Ethanol is not a part of embalming fluid.

Embalming methods

- Arterial.
- Cavity.
- Surface embalming (not commonly used).
- Best method is a discontinuous injection and discontinuous drainage.
- High pressure/low volume method also used.
- Best vessel is the femoral artery.
- Embalming is always done after a post-mortem or receiving the death certificate.
- If embalming is done before postmortem then the doctor will be punished under 201 IPC for disappearance of evidence .
- Body preservation for an unknown dead body done for at least 72 hours.
- Presumption of survivorship → 107 IEA.
 - Nothing is suggestive of death; the person is presumed alive for the next 30 years.
- Presumption of death → 108 IEA.
 - Nothing has been heard about a person from family or relatives for 7 years.

Emptying of stomach

- Determination of time since death.
- Light meal after 1-2 hours.
- Medium-sized meal after 3-4 hours.
- Heavy meal after 5-8 hours.
- Identification of stomach contents done if there was ingestion of food within 2 hours.

Ante-mortem vs Post-mortem blister

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	Ante-mortem blister	Post-mortem blister
Content	Inflammation. Chloride. Protein (mainly, albumin).	Gas.
Base	Erythematous.	Pale.
Redness	Present.	Absent.
Enzymatic/ Vital reaction	Present.	Absent.